JPRS-USP-93-005
5 October 1993

FOREIGN BROADCAST INFORMATION SERVICE

# JPRS Report

# Science & Technology

## Central Eurasia: Space

# Science & Technology

## Central Eurasia: Space

JPRS-USP-93-005 5 OCTOBER 1993

CONTENTS

## History, Prospects of Orbital Space Station Programs

*937Q0190A Moscow ZEMLYA I VSELENNAYA in Russian No 3, May-Jun 93 pp 3-10*

[Article by V. S. Shishov, candidate of technical sciences, chief scientific specialist, Salyut Design Bureau: "Orbital Stations: Idea and Its Embodiment"]

[Text] The idea of constructing manned orbital stations in a circumterrestrial orbit was expressed long before the launching of the first space rocket by many of the pioneers of world cosmonautics: K. E. Tsiolkovskiy, Yu. V. Kondratyuk and F. A. Tsander wrote about this in Russia, as did many of their contemporaries in Europe—H. von Pirquet, H. Oberth, W. Homan, and others. Almost all of them regarded an orbital station as an intermediate refueling point during distant flights to other planets of the solar system or to the moon. In their projects orbital stations were represented as large structures, usually annular in configuration, rotating about their axis for generating gravity, outfitted with cabins, laboratories, greenhouses and other conveniences for the occupants.

Possibly in the future stations will acquire precisely such a form, but the real paths to the mastery of space were far more prosaic than those which theoreticians visualized at the beginning of the century. Both spaceships and orbital stations were designed with allowance for strict limitations on weight and size dictated by the parameters of modern rocket systems.

The first space stations appeared in the Soviet Union and the entire manned flight program in our country was structured precisely on their operation. Space was mastered by the manned Soyuz ships in their different modifications, Progress cargo ships and transport supply ships (TSS). Using them in the 1970's the USSR constructed orbital space stations and transport ships of several types which could support operation of a station over the course of a long time, delivering cosmonauts, freight and fuel to it.

In the United States the launching of the Skylab station was more of an episode than the result of implementation of a long-range program. There was only a single copy of the Skylab station, being serviced by modified Apollo ships.

### Salyut Orbital Stations

In our country the development of orbital stations began in the mid-1960's in the design bureau headed by S. P. Korolev (Energiya NPO). Simultaneously in the design bureau headed by V. N. Chelomey (Mashinostroyeniye NPO) designing began for the Almaz orbital complex, which it was proposed be used for defense purposes.

In order to accelerate work it was decided to combine the efforts of three rocket-space organizations: Energiya NPO, Mashinostroyeniye NPO and Salyut Design Bureau. The orbital stations constructed by them are divided into three generations, first generation—Salyut-Salyut-5, second generation—Salyut-6, Salyut-7, and third generation—Mir.

The Salyut, Salyut-4, Salyut-6, Salyut-7 and Mir orbital stations with purposeful modules were developed at the Energiya NPO in collaboration with the Salyut Design Bureau, whereas the Salyut-2, Salyut-3 and Salyut-5 were constructed by the Mashinostroyeniye NPO. From the very beginning it was determined that the Salyut complex would include an orbital station put into space without a crew by a Proton booster, and the Soyuz spaceship, delivering cosmonauts to the station.

The first Salyut station was put into a circumterrestrial orbit on 19 April 1971. It had one docking unit for docking of the Soyuz spaceship. On 23 April 1971 the Soyuz-10 with a crew consisting of V. A. Shatalov, A. S. Yeliseyev and N. N. Rukavishnikov, which made the first docking with a station, was directed to the Salyut. Thus appeared the world's first orbital complex with a mass of 26 tons. The joint 5.5-hour flight of the ship and station in a single linkup confirmed the correctness of the principles for the approach and docking of space vehicles with the substantially different masses 7 and 19 tons.

The next orbital station, Salyut-2, was launched into orbit on 3 April 1973. However, during the launching into orbit and autonomous flight depressurization of its body occurred and all the systems gradually malfunctioned. The station ceased to exist after 27 days.

Several expeditions of cosmonauts took place on the next stations—Salyut-3, Salyut-4 and Salyut-5; as a result prolonged flights were made and a great volume of diverse scientific information was collected.

The next stage in a further increase in the efficiency and longevity of orbital complexes was the second-generation stations—Salyut-6 and Salyut-7. In contrast to the preceding Salyuts there were already two docking units instead of one and each could receive two transport ships simultaneously. This made possible a considerable broadening of the possibility of work aboard them. The total mass of the complex, consisting of the Salyut 6 station and the two Soyuz ships docked to it, exceeded 32 tons. However, prolonged operation of a station in orbit requires a great amount of rocket fuel for making orbital corrections and maintaining orientation, and also water and food for the crew (the flight of two or three persons for one year provides for the consumption of about ten tons of additional cargo). However, the volume of the pressurized compartments on the Salyut station is limited—50 $m^3$. Accordingly, the regular supplying of the Salyut-6 and Salyut-7 stations was accomplished by the Soyuz spaceship, the Progress transport cargo ship, as well as the Cosmos transport supply ship.

Regular trips of the Progress transport cargo ships from the Earth into space began regularly in 1978. On 26 January 1978 the first ship approached the docking unit of the Salyut-6, having on board about 1300 kg of cargo

and about 1000 kg of fuel. During the 14 years of operation of the Progress and Progress-M transport cargo ships in space they made 53 dockings to the Salyut and Mir stations and delivered to the stations more than 70 tons of cargo and 50 tons of fuel.

An important stage in the history of the Salyut-6 and Salyut-7 stations was the introduction of the Cosmos TSS. On 19 June 1981 the Cosmos-1267 TSS was docked to the Salyut-6 (the total mass of the resulting complex attained 40 tons). For more than 400 days its orbit was regularly corrected by the engines of the Cosmos-1267 TSS and this considerably lengthened the lifetime of the station. Later the Cosmos-1443 and Cosmos-1686 TSS were used for supplying the Salyut-7 station. Complexes with a mass of 47 tons (Salyut-7, TSS and Soyuz) were created in the Earth's orbit. Each mentioned transport supply ship put 6 tons of cargo into orbit (the volume of the pressurized TSS compartment was 48 $m^3$). Due to these ships the Salyut-7 station was ensured an eight-year resultant lifetime in circumterrestrial orbit. Whereas the Progress transport ships, docking to the station, were dependent on it, the Cosmos-1443 and Cosmos-1686 TSS from the moment of docking with the station supplied themselves with electricity, but in case of necessity its systems also could be supplied additional current. In addition, the Cosmos-1443 and Cosmos-1686 TSS had return modules in which each delivered to the Earth more than a half-ton of different kinds of cargo. Thus, the TSS were not cargo ships alone with two-directional movement, but also space transfer vehicles. In actuality these were additional working modules of the orbital complex which in case of necessity could be easily transformed into a specialized laboratory. Later at the Salyut Design Bureau modules for different purposes were constructed on the basis of the Cosmos TSS for their docking with the Mir station.

**Mir Orbital Station**

The Mir station belongs to the third generation and began its flight on 20 February 1986. It has two moorings with docking units to which the Soyuz spaceship can be docked for the delivery and replacement of a crew, unmanned modules for different purposes and the Progress cargo ships. One of the station moorings was outfitted with a device by means of which the modules docked to the mooring can be redocked to four side units and which is situated there in the course of operation of the Mir station. Such a design of the complex base unit for the first time made it possible to create in space a multipurpose manned complex of the modular type. The equipment of the specialized modules docked to the base unit makes it possible to carry out a still greater volume of different kinds of research in the interests of science, the economy and environmental protection in comparison with the Salyut station.

The "Kvant" astrophysical module was docked to the base unit of the complex in April 1987, the "Kvant-2" resupply module in December 1989 and the "Kristall" docking-technological module on 10 July 1990. As a result, a complex with a mass of 90 tons was created in orbit.

Seventeen international expeditions with the participation of cosmonaut- researchers from different countries of the world took part in the flights of the Salyut and Mir orbital stations. The cosmonauts V. G. Titov and M. Kh. Manarov established an absolute record for flight time in orbit—one year (from 21 December 1987 through 21 December 1988).

The successful uninterrupted operation of our manned orbital complexes, especially of the second and third generations, was in many respects determined by the fact that the base units of the station, Cosmos heavy transport supply ships and the purposeful modules were put, and are still being put into circumterrestrial orbits by the Proton booster. Already created in the Salyut Design Bureau in the mid-1960's and subjected to a number of modifications, this was one of the most reliable and economical boosters in the world.

**Skylab Orbital Station**

The American Skylab manned orbital station was designed in the 1960's. The orbital unit of the station was constructed on the basis of the third stage of the Saturn-5 booster, delivering man to the moon. Its hydrogen unit was restructured into an ample two-story room for a crew of three men. The total internal volume of the pressurized station compartments, together with the modified main unit of the Apollo spaceship docked to it, was about 330 $m^3$.

In contrast to our country's stations, the water, food and clothing for the Skylab were supplied in special containers prior to launching in a quantity adequate for all nine astronauts of the three planned expeditions. The water was in tanks. The mass of food stored in cupboards, refrigerators and freezers was about 907 kg. There were two docking units—axial and lateral—for docking with the Apollo spaceships.

The Skylab station without astronauts was put into orbit by a Saturn-5 booster on 14 May 1973, that is, two years after the Salyut station was put into orbit. During launching into orbit the station sustained damage: the oncoming air flow tore away a panel of solar cells and an antimeteorite screen. A second panel, after entry into orbit, could not be deployed because it was stuck by a piece of metal from the antimeteorite screen which had been torn away. Despite this damage the modified main unit of the Apollo spaceship, put into orbit by a Saturn-1 booster, which carried the astronauts C. Conrad, J. Kerwin and P. Weitz, was docked to it on 26 May 1973. After docking the astronauts in the course of multihour and sometimes dramatic work carried out operations in open space for the installation of a new light screen protecting the orbital unit against overheating by solar radiation and deployed the remaining panel of solar cells. This made it possible to ensure normal supply of the station with

electric power and to restore the stipulated temperature regime within the living compartment.

The mass of the Apollo spaceship attained 13.4 tons (the working volume of the pressurized compartments was 10 $m^3$), but after the docking the total weight of the Skylab-Apollo complex already attained 86 tons.

Despite all the difficulties, rockets delivered three crews to the damaged station. The total duration of all three space expeditions exceeded 171 days. The Skylab station itself existed in orbit for six years and burned up upon entry into the dense layers of the atmosphere on 11 July 1979.

**Spacelab Orbital Laboratory**

Development of the Spacelab multipurpose orbital space laboratory began late in the 1970's under a joint program of NASA and the European Space Agency (ESA). The laboratory is assembled from several pressurized compartments and open unpressurized platforms. The pressurized compartments are cylinders whose maximum volume is 22 $m^3$. They are equipped with locking chambers and ports. The laboratory holds scientific instruments and other removable equipment whose makeup changes from flight to flight, depending on the tasks to be performed. The total mass of the Spacelab attains 9.5 tons. The laboratory is located in the cargo compartment of the multiply reusable Space Shuttle transport spaceship (MTSS).

The first flight of the Spacelab 1 laboratory took place aboard the orbital stage of the Space Shuttle MTSS from 28 November through 8 December 1983. During this time the astronauts tested the laboratory, finalized the method for its operation and carried out 70 experiments under the NASA-ESA program. The Spacelab flight confirmed that the presence of a man aboard an orbital laboratory makes possible the on-line elimination of malfunctions arising in the course of a flight. For example, in the course of the first expedition the astronauts repaired three instruments which had malfunctioned.

The second and third flights of the Spacelab 2 and Spacelab 3 laboratories took place in 1985 aboard the Space Shuttle MTSS orbital stations. These laboratories differed from one another in that on each flight they were assembled from a different number of standard pressurized compartments and platforms, which made it possible to put different kinds of scientific equipment in them.

On these and on subsequent flights of the Spacelab laboratory research was carried out in the field of space biology and medicine, space materials science, astronomy, atmospheric physics and the dynamics of fluids.

**Future Development of Orbital Stations**

The launching of the Spektr module and the Priroda module for remote sensing of the Earth with their docking to the Mir is planned for 1993-1994. To a certain degree the prototype of these modules was the already time-tested Cosmos TSS. The modules were fabricated and are now undergoing surface tests.

The next stage in the orbital operation of the Mir complex will be the docking of the multiply reusable Buran spaceship to it. The Kristall module, earlier docked to the Mir station, also has a second docking unit to which the Buran also will be moored. In this event an orbital complex with a mass of more than 200 tons will appear in circumterrestrial orbit.

An agreement has been reached that in 1993 a Russian cosmonaut will be able to participate in a flight in the American Space Shuttle and an astronaut from the United States will be included in the crew of the Mir orbital station. A study also is being made of the possibility of docking of the American Space Shuttle MTSS with the Mir complex.

It is proposed that the Mir complex will operate in space during 1996- 1997, that is, for more than 9 years, and its main unit will require replacement. Now at the Salyut Design Bureau, Energiya NPO and at the Khrunichev Plant a new vehicle of such a type is being constructed which is conditionally called the Mir-2. Put into a circumterrestrial orbit by the Proton booster, it will be docked by the Buran spaceship to the Mir base unit present in orbit. Then by means of the Buran spaceship manipulator the cosmonauts will redock to the Mir-2 two or three modules earlier making up part of the Mir complex. Thereafter several Progress-M cargo ships will undock modules of the Mir complex which have served their time and sink them at a stipulated point in the ocean.

According to an estimate by foreign specialists, orbital space stations are capable of yielding enormous profits when they are efficiently used. Accordingly, the leading Western countries are working on constructing their stations. For example, during 1995-1996 a number of American firms, in cooperation with European and Japanese companies, will begin to assemble the Freedom station in orbit. A total of 22-26 flights of the American Space Shuttle will be required for the initial assembly of the station in orbit. The mass of the future station will be 300-320 tons. It is proposed that it will include four pressurized units: American manned unit, American laboratory unit, manned unit of the European Space Agency and a multipurpose laboratory. By the late 1990's there should be four astronauts constantly aboard the station. In addition, within the framework of the European Space Agency, in which the main role is being played by France, development work is being carried out on the Hermes manned multiply reusable ship. The designers are working out the possibility of its docking with the Russian orbital station. France is now making preparations for manned flights in this ship. The Hermes launching is planned for 1998.

A major work program for the conquest of space has been developed in the Chinese People's Republic (CPR). In early April 1992 a report was published in China which had been approved by the CPR State Council in which it was stated that already before 2000 China will launch an unmanned spaceship and then a manned flight will be made. Manned spaceflight, according to the report, is one of the most important objectives of the Chinese space program during the period prior to the beginning of the next century. Preparation for spaceflight is now regarded as one of the principal directions in the CPR national space program. It also was noted in the report that before 2020 the CPR will launch an experimental space station which will be used in solving economic, military and social programs. During the next 30 years Chinese plans call for the development and construction of a multiply reusable transport spaceship similar to the Space Shuttle MTSS. A space vehicle of intermediate size, intended for manned flights, will be developed prior to 2000. It will include modules for carrying out technological experiments. At the same time preparations are being made in China for the creation of a space transport terminal combining the mentioned modules and cosmonaut living compartments. The development of such a terminal should be completed prior to 2020. At the same time plans call for constructing a manned flight control center. In addition, the development of new launching facilities will be continued, including heavy boosters for the launching of manned vehicles. According to plans, the operation of the new-generation rockets will begin prior to 2020. The rocket-space organizations of the CPR for the acceleration of work on the creation of manned space vehicles are now establishing business contacts with the corresponding design bureaus and institutes of our country, especially the Salyut Design Bureau.

**Chronology of Flights of Manned Orbital Stations**

Orbital station: Salyut Country: USSR Launching date: 19 April 1971 Date of flight end: 11 October 1971 Flight duration: 6 months Transport supply ship: Soyuz Mass in orbit: 25 tons Notes: World's first manned orbital station

Orbital station: Salyut-2 Country: USSR Launching date: 3 April 1973 Date of flight end: 29 April 1973 Flight duration: 1 year Transport supply ship:—Mass in orbit: 20 tons Notes: Ceased to exist due to depressurization of body

Orbital station: Skylab Country: United States Launching date: May 1973 Date of flight end: 11 June 1979 Flight duration: 6 years Transport supply ship: Apollo Mass in orbit: 86 tons Notes: First American manned orbital station

Orbital station: Salyut-3 Country: USSR Launching date: 25 June 1974 Date of flight end: 24 April 1975 Flight duration: 10 months Transport supply ship: Soyuz Mass in orbit: 25 tons Notes:—

Orbital station: Salyut-4 Country: USSR Launching date: 26 December 1974 Date of flight end: 3 February 1977 Flight duration: 2 years 1 month Transport supply ship: Soyuz Mass in orbit: 26 tons Notes: Prolonged joint flight of station and transport ship occurred

Orbital station: Salyut-5 Country: USSR Launching date: 22 June 1976 Date of flight end: 8 August 1977 Flight duration: 1 year 1 month Transport supply ship: Soyuz Mass in orbit: 26 tons Notes:—

Orbital station: Salyut-6 Country: USSR Launching date: 29 September 1977 Date of flight end: 29 July 1982 Flight duration: 4 years 10 months Transport supply ship: Cosmos TSS Mass in orbit: 40 tons Notes: Large-size complex constructed in orbit

Orbital station: Salyut-7 Country: USSR Launching date: 19 April 1982 Date of flight end: 7 February 1991 Flight duration: 8 years 10 months Transport supply ship: Soyuz, Cosmos TSS Mass in orbit: 47 tons Notes: Large-size complex was created in orbit with transfer of cosmonauts

Orbital station: Mir Country: USSR Launching date: 20 February 1986 Date of flight end:—Flight duration: Still continues Transport supply ship: Soyuz, Progress, Kvant, Kvant-2, Kristall Mass in orbit: 94 tons Notes: Modules ensured long-term functioning of complex in orbit

COPYRIGHT: "Nauka" "Zemlya i Vselennaya," 1993

## Cosmonaut Candidate Drowned During Training Exercise

*937Q0179A Moscow TRUD in Russian 6 Aug 93 p 4*

[Interview by Valeriy Ivanov with Svetlana Omelchenko and Valeriy Baberdin, cosmonaut-researchers: "In an Underwater Trap. Cosmonaut Candidate Perished During Survival Training"; the first paragraph is an introduction]

[Text] This has already been reported in TRUD. Requests of readers that we report on the details of the tragedy forced us to return to what had taken place. Journalists, cosmonaut-test pilots Svetlana Omelchenko and Valeriy Baberdin agreed to assist us. Together with Sergey Vozovikov they underwent the general space training course at Zvezdnyy.

**Valeriy Baberdin:** Three years ago at the State Commission we received permission for training at the Cosmonaut Training Center. The difference was that we, journalists, were assigned to the Cosmonauts Detachment and Sergey Vozovikov went there as a standard cosmonaut-test pilot, a future spaceship commander. He was a professional class 1 military pilot, with a flight experience of 1200 hours in MiG-23, MiG-29 and L-39 fighters. All these years he prepared for flight in the Mir

orbital station—trained, attended lectures, took examinations of different types and underwent expert medical evaluation.

**Svetlana Omelchenko:** Incidentally, in the rosters of the training detachment at the Cosmonaut Training Center the group to which Sergey was assigned also was called the "Vozovikov group." He was the oldest in it, the "old man."

**Valeriy Baberdin:** The news of Sergey's death stunned us. After all, everything happened in a tragic play of circumstances. The last day of survival training had passed. Vozovikov, as crew commander, made the decision, using the tackle from the NAZ [portable emergency supplies] kit, to try to catch a fish in the sea. None were caught near the shore. He swam out farther with fins and a mask. He dived. But here there was a strong underwater current, the treacherous nets of a poacher. Who could have thought that such a thing could happen?

He very much wanted to fly into space. He suffered a lot in parting from aviation. You know that the cosmonaut profession is perhaps the most unreliable on the Earth. It was always necessary to be ready to be deprived of it. The very ladder leading to space heights already is painfully steep, and how many treacherous rungs there are on that ladder! And it is a very long path. You're lucky if you fly after five-seven years. And if it is necessary to wait 10-15 years for your "starry hour?"

**Svetlana Omelchenko:** There are statistics indicating that many leave for health reasons. They cannot withstand the accelerations, pace, and lifestyle, they break psychologically. But all this is nothing; one can survive. In these statistics there also are sorrowful figures giving evidence of how many men have perished during flight training. The losses are small, but they have occurred. However tough, the work of a cosmonaut is risky work, even on the land. It is not without reason that flight candidates in the personnel roster are designated as cosmonaut-test pilots. Valentin Bondarenko perished, burning up in an anechoic chamber, Leonid Ivanov died in an aircraft during a test flight, Alexander Shchukin also died, as did Rimantas Stankyavichus. And now Vozovikov.

**Valeriy Baberdin:** The present-day training sessions were organized at the base of the Special Survival Center for AF Flight Personnel, located 20 km from Anapa. Sergey's crew was the youngest. Vozovikov was 35 years old, a second Sergey, Lazutkin, and Sasha Treshchov (both representatives of the Energiya NPO), future shipboard engineers, were approximately the same age. They trained together with the crew which in the autumn was sent into orbit: with Viktor Afanasyev, commander, Yuriy Usachev, ship's engineer, and Valeriy Polyakov, cosmonaut-researcher, a physician.

**Svetlana Omelchenko:** What is sea training like? A simulation of a forced landing of a spaceship in an unknown region. It is carried out in the following way. A descent model is cast into the water, the cosmonauts in spacesuits climb up there, sit for several hours, put on life jackets, take the NAZ kit and rapidly evacuate. The capsule has very little buoyancy and any delay may lead to misfortune. Farther out in the water the crew members must get together and take all measures for their detection. All is seemingly simple, but after all this capsule is terribly small. Visualize how it is possible to put three stout fellows in three cubic meters of volume. And all around there are instruments, projections, packings, seats, exceeding inconvenient for terrestrial conditions.

**Valeriy Baberdin:** Plus the hellish heat, plus the diabolical rolling and exhausting burden of weightlessness. Sasha Treshchov later stated how in the practice training, when everything was like real, he, together with Sergey Lazutkin, reached a point of total despair, feeling that they right then and there would throw up from the rolling and closeness. But how to jump out when it is even impossible to move an arm? But then the commander told a story and began to sing, forcing them to join in the singing... Then everything sort of settled down.

**Svetlana Omelchenko:** Serezha could handle anyone. Valeriy, do you recall how the two of us underwent survival training in the desert? You and I were then in the same crew and he in another. The heat was awesome and we constructed a curtain from a parachute canopy. Taking shelter beneath it, I still was hot. You lay down and look with melancholy on the vessel containing water. It contains about five liters of water for three days; there are two more days to come. Involuntarily your head begins to swim. But here, Valeriy, you remember...

**Valeriy Baberdin:** ...Yes, to be sure. I hear over the radio set how "Zarya" (the code name of the instructors headquarters) is calling us. I answer. They propose that we leave the shelter. They said that they were watching us through a stereoscopic telescope. We went out and turned in the direction of the dugout. "'Barkhany' (our code name), raise your arms and swing them." We did as we were ordered. Then they proposed that we jump. We did that. Suddenly it comes to us that this is someone's joke. I hear Sergey's voice: "OK, fellows, don't be offended."

After the sea training the Vozovikov crew had to survive in the mountains. The story is the same: landing of the descent module in an unplanned region. It is necessary to determine the position coordinates, to establish communications with rescuers and to hold on for several days. Everything went normally. The lads precisely determined the landing region, laid out an escape route, passed through a mountain range and by evening began to set up a camp. On the next day—rock climbing, again a trek through the mountains and again the setting up of a camp. The fellows reached the sea, not far from it chose a beautiful glade, alongside which was "Zmeinoye Ozero." The instructors arrived at dinner and checked out the crew's actions. As they say, everything was "OK." It remained to await the night; the morning of the next day was the end of training.

Visualize this. The weather was beautiful, the program was virtually completed. Tomorrow it was to home, to the base, on leave. Lay down and sun yourself. But you have to know Sergey: it was simply impossible for him to sit and do nothing.

At 1500 hours Vozovikov, as crew commander, makes a decision: using the NAZ kit, he would try to get food. And this is understandable. The sublimated foods had become degraded. The sea was right there and there were fish in it. Vozovikov and Lazutkin took the tackle and equipment and went to the sea. Treshchov remained behind to straighten up the camp...

"Near the shore it was shallow, the bottom was sandy, there were no fish there," recalled Lazutkin later. "At a distance of 50 meters we saw a staked-out net. We decided to try and get out there. Everything was normal, it was possible to sit on the float and cast the line. And suddenly this is what happened. When Sergey dived, I immediately presensed misfortune. I went after him. But without a mask I could see nothing. Somewhere at a depth of six meters (my ears began to stop up) I felt a strong current which carried me toward the nets. I surfaced, rushed toward the shore and called the instructors and rescuers... Sergey was tangled in a pocket of the net."

**Svetlana Omelchenko:** I did not know all the details and it is painful to me that such a surprisingly purposeful fellow did not have the opportunity to rise into his space orbits. He will be remembered forever.

## Observations of 4U1700-377/HD 153919 X-Ray Source in Energy Range of 35-1300 keV by Granat Observatory SIGMA Telescope

*937Q0183 Moscow PISMA V ASTRONOMICHESKIY ZHURNAL in Russian Vol 19, No 6, Jun 93 pp 483-499*

[Article by A. F. Sitdikov, M. R. Gilfanov, R. A. Sunyayev, Ye. M. Churazov, A. V. Dyachkov, R. S. Kremnev, K. G. Sukhanov, N. R. Kuleshova, P. Mandrou, J. P. Roques, L. Bouchet, G. Vedrenne, P. Laurent, A. Claret, B. Cordier, A. Goldwurm, Russian Academy of Sciences Space Research Institute, Moscow; National Center for Space Research, Toulouse, France; Astrophysical Service of the Center for Nuclear Research, Sakle, France; Center for the Study of Cosmic Emissions, Toulouse, France; UDC 524.354.6]

[Abstract] The x-ray source 4U1700-377/HD 153919 was in the field of view of the SIGMA telescope in 1990-1992, during which time 15 observation sessions were conducted. The strongest variation in hard x-ray flux was observed during the 12 September 1990 flare activity, with flux 10-fold stronger than previously noted over a period of about 6,000's. The variations on 27 September of that year were observed with a quasiperiod of about 5.4 hr. For characterizing spectrum hardness, approximation of the source spectrum with a thermal bremsstrahlung model yields a temperature of 45 keV. It is noteworthy that source spectrum shape is independent of source luminosity. The telescope recorded a statistically significant flux of energies of up to about 150 keV. Figures 9, references 21: 20 Western, 1 Japanese.

## Spatial Distribution of Particle Streams and Absorbed Dose Intensity in Neighborhood of South Atlantic Anomaly Based on Measurements From Mir Station

*937Q0188A Moscow IZVESTIYA AKADEMII NAUK: SERIYA FIZICHESKAYA in Russian Vol 57 No 7, Jul 93 pp 100-103*

[Article by V. M. Petrov, V. S. Makhmutov, V. A. Shurshakov, N. A. Panova and Ts. Dachev, Biomedical Problems Institute, Russia; Physics Institute imeni P. N. Lebedev, Russian Academy of Sciences; Solar-Terrestrial Relations Laboratory, Bulgaria; UDC 551.521.8]

[Abstract] The measurements made in 1991 with the "Lyulin" dosimeter-radiometer aboard the Mir orbital station revealed the appearance and prolonged (over the course of several months) existence of two additional maxima in the distribution of particle streams in regions adjacent to the South Atlantic magnetic anomaly caused by streams of trapped high-energy electrons. The instrument does not make it possible to separate the contribution of different types of registered particles to the measured dose intensity and flux, but a conclusion can be drawn concerning the predominant role of protons or electrons by using the ratio of the instrumentally registered dose intensity D and the integral flux N. The observations were made at orbital altitudes 380-410 km, inclination 51.6°. The principal contribution to instrument readings could be from protons and electrons having energies outside the station of more than about 100 MeV and more than 10 MeV respectively. The additional maxima were observed in the latitude range -35 - -50° and the longitude range -20 - +20°. The appearance of these spatial maxima is possibly related to earlier powerful solar proton events and the geomagnetic disturbances accompanying them. Figures 2; references 9: 7 Russian, 2 Western.

## Light Curve of Heming Gamma-Ray Pulsar at 400-4000 MeV From Data of Gamma-1 Telescope

*937Q0200 Moscow PISMA V ASTRONOMICHESKIY ZHURNAL in Russian Vol 19, No 7, Jul 93 pp 579-582*

[Article by V. V. Akimov, V. G. Afanasyev, I. D. Blokhintsev, L. F. Kalinkin, N. G. Leykov, V. Ye. Nesterov, A. M. Galper, Yu. V. Ozerov, V. A. Rudko, M. F. Runtso, V. M. Zemskov, L. V. Kurnosova, M. A. Rusakovich, N. P. Topchiyev, M. I. Fradkin, Ye. I. Chuykin, V. Yu. Tugayenko, M. Gros, I. Grenier, A. R. Bazer-Bachi, J. M. Lavigne, J. F. Olive, Russian Academy of Sciences Space Research Institute, Moscow; Moscow Engineering and Physics Institute; Russian Academy of Sciences Physics Institute, Moscow; Russian Academy of Sciences Physical-Technical Institute, St. Petersburg; Energiya NPO, Kaliningrad; Center for Nuclear Research, Sakle, France; Center for the Study of Cosmic Emissions, Toulouse, France]

[Abstract] Gamma-1 data were used to retrieve a light curve for the Heming pulsar with two peaks separated by 0.5+/-0.03 of the period. The light curve is pronounced for gamma quanta with energies exceeding 400 MeV. The upper limit for the pulsed flux at energies of 50-300 MeV is $6 \times 10^{-7}$ $cm^{-2}s^{-1}$. At energies greater than 300 MeV, the power law spectrum for the pulsed component is $1.1_{-0.3}{}^{+1.1}$; integral flux is $(1.1+/-0.3) \times 10^{-6}$ $cm^{-2}s^{-1}$. For energies above 300 MeV, the spectrum of the pulsing component was harder than the spectrum measured by COS-B for total emissions. The source demonstrated high-energy gamma-ray pulsar features that were more pronounced than those of PSR 0833-45 in Vela. Figures 1, references 8 (Western).

## Problem of Orbital Debris

*937Q0178A Moscow TRUD in Russian 21 Jul 93 p 6*

[Article by Igor Tsarev: "Graveyard of Spaceships. Seven Thousand 'Shots' at Our Planet Will Be Made at Random From Space in the Immediate Future..."; the first paragraph is an introduction]

[Text] Human civilization has a surprising property: after conquering the next corner in nature, it is immediately transformed into a dump. "Near space" did not

become an exception. Metal fragments, rocket stages, spy satellites which have served their time and various kinds of containers circle above the Earth in great numbers, from time to time falling downward. They assure us that all this space trash is for the time being no threat. Is this really so?

An interesting letter arrived at the "Fenomen" [Phenomenon] Commission from Kirovograd Oblast. Mikhail Karpovich Zasteba, a machine operator at a local collective farm, while harvesting a wheat field discovered a mysterious object similar to a "sea mine, but without projections." Judging from everything, this "guest" fell from the sky. The soil at the place of falling was somewhat crumbled and had been "coked," as under a high temperature. The weight of the ball, to be more precise a sphere, was 13 kilograms...

Two questions are raised in the letter. One of the inquiries was: "Why did the 'stranger' pay us a visit from space?" The second was purely practical: "Is it possible to safeguard ourselves from such an object falling tomorrow not into an open field, but somewhere in a less safe place?"

**From competent sources:**

According to data from the North American Space Observation Service (NORAD), more than 7000 artificial objects exceeding the size of a beer can (more than 10 centimeters in diameter) are now circulating in circumterrestrial space in a "round dance." Among these only 5% are operative vehicles. The rest are trash. There are 1600 satellites no longer in operation, as well as 5500 different fragments: rocket stages, splinters, chunks... There is even a hammer dropped by American astronauts while working in the cargo department of a spaceship.

All this trash thoroughly irritates the cosmonauts. For example, in July 1983 a dent with a diameter of four millimeters was formed in a window of the orbital station Salyut 7. That same year, during a flight of the Challenger, a "dent" measuring 2.5 cm and with a depth of a half-centimeter appeared in its front porthole. After the landing the glass was examined and the conclusion was drawn that the "transparent armor" was almost penetrated by a flake of paint measuring only 0.2 mm chipped off in space from some satellite. "If this had been a nut, the Shuttle would have come to an end," stated the Americans sorrowfully...

The degree of danger of collision with such particles, the velocity of which in the case of a head-on impact may exceed 15 kilometers per second, is indicated, if by nothing else, by the fact that on the heat insulation panels removed from the Solar Max satellite there were about 2000 openings and dents forming over the course of four years...

"Nevertheless, space trash constitutes no danger for the Earth's inhabitants," say the specialists assuringly. "A high percentage of it burns up during passage through the dense layers of the atmosphere."

And experience for the time being confirms these words. Until now the sole victim of a fragment falling from a spacecraft has been a cow in Cuba, already killed on Libertad Island in 1962. But recall how many times we already have been threatened by space "emissaries!" We will mention only the most significant events.

1979. The Skylab orbital station, weighing about 85 tons, tumbled into the Pacific Ocean, also spraying the coast of Australia with a hail of fragments.

1991. The 40-ton Salyut 7 station, docking with the Cosmos 1686 ship, after an uncontrolled descent, was scattered over the Argentinian cordilleras.

Can such large constructions really burn up in the atmosphere? But what to say if, according to calculations, the notorious American hammer now flying over our heads, successfully reaches the Earth, losing, to be sure, its wooden handle on the way? Who knows where it will fall? And after all there are more than 7000 such objects in orbit. This means that there will be an equal number of dangerous "shots" from space at our planet.

There are regions where space trash falls from the sky with particular frequency. These include, for example, the entire Russian North from Arkhangelsk Oblast to Yakutia, where spent stages, engines and cowlings of rockets launched from the Plesetsk cosmodrome tumble regularly from the sky. According to different sources, from 16 000 to 30 000 tons (!) of "space fragments" have already accumulated in the tundra. But the local inhabitants long ago became accustomed to such a situation and have no complaints about this. On the contrary, they hasten to each newly forming funnel and drag the "metal" to their homes for economic needs. They say that first-class reindeer-drawn sleighs are fabricated from the nose cowlings of rockets.

But such a state of affairs cannot last forever. Even a schoolchild understands that sooner or later human victims are inevitable in such a zone of increased risk. And no one (in response to the letter from M. Zasteba) can guarantee safety for the machine operators in Kirovograd Oblast against space fragments, as is true, however, also for all other machine operators (and others besides machine operators) on the planet. With respect to the mysterious sphere discovered by M. Zasteba in a field near the village of Popelnastoye, the "Fenomen" experts were able to clarify the following.

Beginning in 1976 half the military satellites launched by S-1 boosters during the time of their flight periodically released small objects which descended rapidly... The separated "fragments" had a radar cross section of about 0.1 square meter, and judging from everything, were hollow metal spheres without any "active systems" whatsoever. Up to 1983 the number of such "fragments" shot off from one satellite was 24. Beginning with the Cosmos 1601 this number increased to 28. The Cosmos

1985 satellite, of a new type, released 36 such spheres during the two years of its lifetime.

What were the mysterious "shells" scattered around military satellites? In the opinion of M. Tarasenko, a specialist at the Disarmament Problems Center, these were nothing more than passive probes. Using them it is possible to trace changes in the density of the upper layers of the atmosphere, whose state exerts an influence on the accuracy in control of ballistic missiles. In addition, such "orbital targets" can be used in calibrating surface radar stations or carrying out, for example, simulated attacks for checking antimissile defense systems.

After the conversation with Candidate of Physical and Mathematical Sciences M. Tarasenko even the cloudless blue sky no longer seemed to us peaceful and safe. And it was not a matter of just the ordinary, be it even militar' space trash which at any moment could tumble down from the sky. We learned that there, in high orbits, awaiting their hour, there are circling secret spy satellites with nuclear reactors aboard...

**From competent sources:**

1964. The American Transit satellite experienced an accident and scattered radioactive matter in the atmosphere.

1968. The Nimbus B-1 meteorological satellite with a reactor aboard failed to reach the stipulated orbit and tumbled into the ocean.

1969. Unsuccessful launchings of two Soviet lunar probes, designated Cosmos 300 and Cosmos 305; ended with a crash entry into the atmosphere and with the dispersal of radioactive matter.

1970. After an accident on the Apollo 13 ship the American astronauts were forced, in returning to the Earth, to dump the lunar comp' tment with a nuclear reactor. It was not found despite an intensive search.

Nuclear power plants came into use on Soviet spy satellites beginning in 1967. These vehicles were launched by F-1 boosters from Baykonur and were intended for the radar tracking of the American navy and the ships of its allies. The reactor supplying power to the sounder contained more than 30 kg of 90% uranium-235.

However, precautionary measures also were taken: when a satellite had reached the end of its useful life it was "thrust" into a higher orbit (about 1000 km), where it could revolve, without falling, another 300 years. It must not be thought that during this time the reactors will become less dangerous. To the contrary, it is more likely that the plutonium aboard is more radioactive and has a half-life of 24 000 years.

In January 1978 the Cosmos 954 satellite suddenly was depressurized and after uncontrollable descent tumbled in a hail of radioactive fragments into the northern part of Canada. After a flaring international scandal the Soviet Union assumed half the costs on the cleanup of the polluted territory and paid the Canadians three million dollars.

The second such event already occurred in 1982: the Cosmos 1402 could not be put into a higher orbit and it began to fall. The reactor contents were scattered over the South Atlantic.

In 1988 still another Cosmos with a nuclear "filling" lost control. Only at the very last moment were engines fired which thrust the "spy" into a 1000-km orbit. Thereafter we desisted from using nuclear power plants. But by that time about 35 such "bombs" had already been accumulated in orbits around the planet. It would seem that this was quite enough, but...

Recently at one of the scientific conferences in Moscow there was serious discussion of a project for the "burial" of nuclear wastes in circumterrestrial orbits. The latest booster, the Zenit, was proposed for transporting the containers into space...

**And now information for reflection:**

The Zenit was developed at the Yuzhnoye NPO (Dnepropetrovsk) during 1975-1986. Although the Zenit is one of the highest-tech boosters, its use is being held back. This is probably attributable to the fact that among the 15 launchings at least four were unsuccessful; the last three accidents occurred one after another

The following is a chronology of the last unsuccessful launchings of the Zenit from Baykonur cosmodrome:

October 1990. Did not enter into orbit due to failure of the first stage.

August 1991. Did not enter into orbit due to failure of the second stage.

February 1992. Did not enter into orbit due to failure of the second stage.

Children have a game in which they throw a small ball upward while crying out "Let it land where it will!" and wait breathlessly until it falls. But we, after all, are not children, and rockets with a nuclear "filling" are not harmless balls. Do we not have the common sense not to aggravate the situation with space trash? Even without this an enormous cemetery of dead spaceships drifts above the Earth, from time to time raining metal fragments downward.

## Dynamics of Orbital Film System With Double Rotation

*937Q0185 Kiev PRIKLADNAYA MEKHANIKA in Russian Vol 29, No 5, May 93 pp 88-95*

[Article by V. I. Gulyayev, A. A. Grom, V. L. Koshkin, and P. P. Lizunov, Kiev Structural Engineering Institute, Kiev; UDC 534:539.3]

[Abstract] A problem is examined involving motion relative to the center of mass of an orbital system consisting of two solids bound to each other with a hinge. One of the solids carries a flexible, rotating membrane disk (a film reflector). In the study of the dynamics of component satellites, mechanical systems consisting of the main component and a flywheel are usually called systems with double rotation. The spinning of the membrane disk makes it possible to solve two problems at the same time: that of maintaining the shape of the thin film, and that of creating a gyroscopic system for controlling the angular position of the entire satellite complex. The solution of the second of the problems is possible when the system has a zero angular momentum. Then the kinetic variation of the orientation of the axis of the spinning disk and the axis of the carrying component relative to each other makes it possible to control the motion of the entire system relative to the center of mass. That principle is being used in the development of space-based solar reflectors and solar-sail-equipped spacecraft. The researchers here construct a mathematical model of an orbital film system with double rotation to study the dynamics of the transition processes associated with the controlled variation of the two axes relative to each other. Figures 5, references 4 (Russian).

## Problems Involving the Study of the Effectiveness of Aviation/Space Systems

*937Q0163 Moscow GEODEZIYA I KARTOGRAFIYA in Russian No 2, Feb 93 pp 31-36*

[Article by Yu. P. Kiyenko, V. V. Ostroukhov; UDC 528.7(202)]

[Abstract] Over the last several decades, the former Soviet Union garnered an immense amount of science-related and industrial potential involving the creation of aviation/space systems. At present, conversion is presenting the challenge of efficiently using such systems to handle tasks associated with the economy, science, and defense. Aviation/space systems hold specific advantages over systems without the airborne component: higher degree of readiness, collection and delivery of data in a more prompt fashion; and reusability. Since the nature of the functioning of the aviation/space systems is such that it does not lend itself to description by traditional mathematics, new mathematical models must be developed. The first question that must be asked involves a determination of what models need to be developed, how complex the models must be, and how the models will complement one another. After the makeup of the models is determined in terms of levels defined by research purposes and objectives, they must be refined to include a description of processes, plus modeling algorithms. By and large, attention must be focused on methodological support of research and verification of system need; on arrangement of research priorities; and on sensible choice of the technical, economic, and operational characteristics of the systems in the context of limited resources.

## Analysis of Hydrobiological Conditions in Lake Onega From Data of Combined Space-Based Radar, Airborne, and Contact Measurements

*937Q0166 Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 3, May-Jun 93 pp 91-101*

[Article by M. A. Naumenko, V. S. Etkin, K. Ts. Litovchenko, A. V. Smirnov, D. V. Beletskiy, V. B. Rumyantsev, Institute of Limnology, Russian Academy of Sciences, St. Petersburg; Space Research Institute, Russian Academy of Sciences, Moscow; UDC 528.88.044.1:551.465.16]

[Abstract] Results are presented from a combined limnological experiments performed over Lake Onega in July 1989. Experiment participants consisted of the Institute of Limnology of the USSR Academy of Sciences (ship-based contact measurements); the Polar Institute of Fisheries and Oceanography (airborne IR radiometer and visual observations), and the USSR Academy of Sciences Space Research Institute and NPO Mashinostroyeniya (radar scans performed by SAR aboard Almaz-0, aka Kosmos-1870). The following conclusions were drawn about Lake Onega on 14 July 1989 as a result of the analysis of the experimental data. In the radar scans, the eastern half of the lake showed elevated concentrations of phytoplankton stemming from favorable weather and water-circulation conditions. Visual observations and the distribution of depth transparency confirmed the presence of the phytoplankton. Dying off of the organisms resulted in the release of a considerable quantity of gas bubbles to the surface. The resulting roughness of the surface (absent windy conditions) increased the scattering of the radar signals. In the western half of the lake, wind waves produced radar-signal intensity variations; temperature and transparency distributions differed considerably from those in the eastern half. The researchers found that hydrobiological processes can be a source of radar contrasts. Figures 5, references 6 (Russian).

## Policy Problems With Environmental, Economic Satellite Programs

*937Q0170B Moscow NOVAYA YEZHEDNEVAYA GAZETA in Russian No 10, 11 Jun 93 p 4*

[Article by Oleg Volkov, under the rubric "True State of Affairs": "Satellites in Space: Will We Again Go Our Own Way?: The Russian Space Agency Is Getting Ready To Invest Money Into Ground Development"]

[Text] It would seem that, after losing some of the global space programs, Russia still couldn't stabilize the situation in the space sector. With every passing day, it becomes increasingly apparent that we are having a lot of trouble just maintaining the level we have reached. If truly expensive projects were "frozen" several years ago, recently the deputy general director of the Russian Space Agency, Yuriy Milov, announced that the RSA intends to abandon the design and creation of new weather and natural-resources satellites whose cost is in no way comparable to, for example, the well known Buran-Energiya program.

In the meantime, the talk is not of the abandonment of "small" space, but of the reorganization of small space. Slated for this year is the launch of seven satellites (two Meteor, three Resurs-F, one Resurs-O, and one Okean). In Milov's words, those models will also be used in the future (at best, in a slightly modified form). No one knows whether the Almaz complex—a very expensive vehicle that has been aloft twice already (1987-1989 ad 1991-1992) and has garnered international acclaim—will be completed and launched.

It would seem that the reason for the new turn of space "freezes" lies on the surface—inadequate funding. According to Milov, the 5 billion rubles [R] earmarked this year for those purposes is clearly not enough. Of the Commonwealth countries, only Ukraine and Belarus have thus far agreed to take part in the project.

But there's another way of looking at the problem associated with national-economy satellites. Here's

what cosmonaut Valentin Lebedev, who now heads the Science Geoinformation Center in the Russian Academy of Sciences, says:

"We have in fact created unique systems: spacecraft, station modules, satellites. But in investing money in space, we have completely ignored the development of the ground-based infrastructure that supports needed communications whatever is in orbit. And where does the information obtained in space go now? When I was aloft on the Salyuts, I was sure that someone on the ground could use our information. After I came back down, I made went to see geology groups, science institutes, steamship companies, and forestry concerns, and here's what I found: the information, if it even gets to them, gets to them very late. We need a new system for the direct linkup of the ground and space. One in which anyone from any region can order the information he needs—on the weather or the development of geological and environmental processes—and in which that information will get to him quickly and directly, bypassing bureaucrats and middlemen. I wouldn't mind spending money for that. Such a system could be called the return mechanism for the money that has been invested in the space program. We can no longer support the space sector with words—we need to vote for it with the ruble."

According to Lebedev, the Science Geoinformation Center he heads was created for just such purposes. The concept is under development for regional centers and databases linked directly to orbit, which should make it easier for consumers to have access to space information.

Milov assures us that the Russian Space Agency, which for some reason isn't not paying any attention to Lebedev's initiative, intends this year to conduct a competition for the best design of an "Earth-Space" system and to implement that design.

By the way, unlike most space projects, the plans for the "national-economy space program" are geared exclusively to domestic consumers—because we can't offer anything fundamentally new on the world market in that area. In addition, our space communications frequencies, the format of the satellite information, and the forms of archivization of that information differ from world standards, which we are only getting ready to switch over to. But almost the entire world—even China and most of the Eastern European countries—has long been using the American Landsat system. It is rather convenient and does not require that the user have any lengthy specialized training, which makes for direct access to space data not only for scientists, but also for businessmen, industrialists, agronomists, and even government officials.

It's also beneficial to the government—since taxpayer money doesn't fly off into space without coming back. True, according to the estimates of domestic specialists, even the Americans get a return of no more than 10-15 percent of what they spend on "national-economy space." But even the Americans themselves tend to blame the financial failures that have in fact befallen Landsat in the past few years (in the spring they even had to announce the selloff of some unique archives) on the premature privatization of that system—its now-former owners were counting on some not-very-wealthy research centers and laboratories. Now, with Landsat again under governmental control, the Americans are preparing to make another attempt to create a user network capable of recovering all the expenses on space.

But in Russia, the use of Landsat will long remain beyond our financial reach—and, too, that system is not capable of completely meeting the demand of domestic consumers. All that is left is to hope that the Russian taxpayers will be patient enough to create our own such system. Even with a 10-percent return.

## RSA Deputy Director on Russia's Environmental Monitoring Capabilities

*937Q0170A Moscow VOSTOCHNYY EKSPRESS in Russian No 21-22, 19-25 Jun 93 p 13*

[Article by Yuriy Milov, deputy general director of the Russian Space Agency, under the rubric "'Voice of the Universe: We Can See Everything From Aloft...But Do You Need That?': A Panacea for Many Troubles—Remote Sensing of the Planet"]

[Text] The state of the environment is one of the most acute socioeconomic problems we face, as it directly or indirectly affects the interests of every person. In all the developed countries of the world, meteorological and ecological information has become the object of the especial attention of official authorities and political parties, social movements, the mass media, and broad segments of the populace.

For Russia, where the processes of radical fracture of economic relations are taking place against the backdrop of serious and, in some places, catastrophic ecological situations, the need for open, objective, and reliable official information on the state of the environment and natural resources is especially acute.

To get a confirmation of the urgency and timeliness of the monitoring and forecasting of the state of the natural environment one need only call to mind such large-scale natural problems as the greenhouse effect and global warming; the growing destruction of the ozone layer; the occurrence of regional environmental disasters such as the lowering of the water level in the Aral sea and the rise in the water level of the Caspian; radioactive and chemical contamination of surface and atmosphere; the across-border migration of pollution; large technology-related accidents; and natural disasters (flooding, forest fires, volcanic eruptions, typhoons, earthquakes, etc.).

At the turn of this decade, the total yearly losses to Russia from adverse environmental situations, natural disasters, and emergency situations already exceeded 50 billion rubles [R] (in 1991 prices); according to the forecasts of ecologists, that figure will at least double by the year 2000. At the same time, domestic and foreign experts estimate that at least one-third of those losses can

be prevented with timely preventive and rescue operations based on up-to-date information from systems of meteorological and environmental monitoring of the natural environment.

An important place in that system must go to space-based equipment for remote sensing of the Earth, equipment with such unique merits as global view, day-to-day acquisition and delivery of information to analytical centers, and maximum productivity and minimum cost per unit of information. In light of that, one could say that the creation and improvement of space-based weather- and natural-resource-monitoring systems represents a modern-day top-priority task that affects the safety and viability of all mankind.

At present, hydrometeorological information is provided to sectors of the national economy by a system of mid-altitude Meteor-3 satellites whose operation makes it possible to improve the reliability of weather forecasts as a result of the global information it receives on the state of the atmosphere and the underlying surface. Ground weather stations—and there are more than 10,000 of them on the globe—cannot do that. They cannot provide information on the immense expanses of ocean, and there are few weather stations in hard-to-get-to areas of land and the icy expanses of the Arctic and Antarctica. Ground-based meteorology equipment is "blind" to nearly 80 percent of the planet.

Okean-01 oceanographic satellites have been launched since 1979 for the purpose of providing regular monitoring of storm and ice conditions in the vicinity of the Northern Maritime Route and the transportation routes of the world ocean independent of time of day or cloud conditions.

Weather and oceanographic satellites help in the rapid acquisition of data involving, for example, temperature, humidity, precipitation areas, cloud-structure distribution, presence of atmospheric fronts, and emergence of cyclones from the entirety of the Earth's surface. Information from the Meteor system is used at present by all the countries of the CIS and by countries that are members of the World Meteorological Organization.

To handle problems associated with the efficient use of natural resources and the monitoring of inhabited environments, satellites that effect day-to-day and photographic observation of the Earth's surface are launched on a regular basis. The materials of the space-based survey are used to create new topographic and thematic maps and update the old ones, produce cadastres of various natural resources, explore territories for purposes of construction-engineering, city planning, and planning of economic activity. At present, there is a vast bank of high-quality space photos of many regions of Russia and the other countries of the former USSR; the bank has great practical and scientific value, and that includes for purposes of environmental research.

Space-based surveys have found regions in Western Siberia, in Fergana, on Mangyshlak Peninsula, and in Kara-Bogaz-Gol Gulf that hold promise in terms of the search for oil, gas, and other minerals; the surveys have also been used to update topographic and thematic maps of much of Russia and other CIS countries. Exploratory drilling in areas expected to have oil and gas beds has verified the presence of industrial-scale reserves of those minerals.

Satellite images of the Earth's surface clearly define smoke plumes from industrial enterprises, volcanoes, and large fires. Satellite images covering a vast area have recorded plumes of atmospheric releases of the Ekibastuz State Regional Electric Power Plant that span dozens of kilometers. There is a possibility that space photos may be able to be used to estimate the extent of pollution of areas around enterprises that release materials into the atmosphere.

Foreign and domestic space-based system are in the initial stages of their development. Commercial services offered to consumers by those systems are estimated at present to be worth around $200 million and do not come near recovering the monies spend on their creation and operation. All foreign systems for the remote sensing of the Earth are funded out of [state] budgets. By way of example, one can point to the fact that NASA's budget appropriations for applied space-based systems have been approximately $2 billion, against total NASA spending of an estimated $10-15 billion.

To put it succinctly, we have unique information at our disposal. It isn't always asked for by potential consumers, however, and sometimes it goes unused. That's not just our misfortune: it is known that in the well-off United States, nowhere near every farmer uses the satellite-information services, and that's simply because he doesn't want it. The Russian consumer, however, is even less ready to look at such information.

So, we'll have to educate them!

## Third-Generation Almaz Satellite To Be Launched in 1996

*937Q0182C Moscow VECHERNAYA MOSKVA in Russian 2 Aug 93 p 7*

[Unsigned article: "Despite Terrestrial Difficulties"]

[Text] At the Machine Building Plant imeni M. V. Khrunichev work is being done on constructing the third-generation Almaz-1V automatic orbital station. The station launching is planned for 1996. The station will be outfitted with a three-frequency on-board radar outfit for surveying the Earth's surface with a resolution 5-7 m and optical equipment for a stereophotogrammetric survey of the Earth's surface.

This will be the third automatic station of the Almaz type. The first station, Cosmos-1870, operated in orbit

during the period 1987-1989. It was outfitted with a single-frequency radar with a resolution 25-30 m.

The second station, Almaz-1 with a modernized radar, which made it possible to survey the Earth with a resolution 10-15 m, flew during the period 1991-1992.

Despite the difficulties experienced by the plant, here thoughts are on the future: the next station, Almaz-2, whose launching is planned for 1998, is being designed.

[Two photographs show work in progress within the pressurized body of the future Almaz-V station.]

## Development of First Soviet Photoreconnaissance Satellite 'Zenit'

*937Q0197A Moscow PRIRODA in Russian*
*No 4, Apr 93 pp 72-78*

[Article by Yu. M. Frumkin, candidate of technical sciences, deputy director, Design Section, Energiya Scientific Production Association]

[Text] In the history of cosmonautics there are many bright pages known to the entire world, but there also are many secrets.

This article is devoted to one of the largest Soviet secret programs, the story of the development and flight tests of spy satellites. Precisely such was the purpose of each third satellite launched in the 1960's-1970's in the USSR under the Cosmos program.

A paradox of history! A fundamentally new tool for obtaining very detailed information on enormous regions of the Earth, making it possible to collect this information on an on-line basis and to update it with virtually any frequency, for long years served only the political purposes of the United States and the USSR. Invaluable data on the state and dynamics of processes directly related to ecology, the use of natural resources and also other information concerning our planet so necessary for mankind was stored in military departments and stamped secret.

The United States as a rule usually announced everything about the launching of their secret satellites, although it did not reveal their purpose and characteristics. The Soviet Union for long years did not even once mention this in any official publication.

Now everything is in order. First, the events and facts related to the development in the Soviet Union of the Zenit spy satellite, as well as the problems involved in creating this new type of space vehicle, second, some considerations with respect to the mysterious Cosmos program, in which the number of launchings during the more than 30-year history has already exceeded the 2000 limit. Launchings of the Zenit space vehicles were a major component of this global program.

### Chronicle of Principal Events

Active research and design work on the Zenit spy satellite began at the Experimental Design Bureau No 1 (OKB-1) in 1957, a year after its organization. The legendary Chief Designer Sergey Pavlovich Korolev headed the OKB-1.

Design work on the spy satellite was completed in mid-1961. By that time (such speed was a special feature of the style of S. P. Korolev) the OKB-1 had already fabricated the first space vehicle and had carried out its numerous and many-sided surface tests.

Korolev assigned enormous importance to the initial planning stage. As a rule many variants were considered. It withstood a struggle of opinions and this facilitated the search for original solutions. After choosing the variant adopted for realization Sergey Pavlovich became tough and demanding, setting a fast pace which all the participants took up with enthusiasm.

Tasks went on side by side, unsolved problems did not stop the creation of mockups, units, assemblies and apparatuses for the checking and finalization of all components and the space vehicle as a whole. Then the pace slowed down. This was a period of analysis of the results. Decisions were made about further developments if they were necessary. In general, however, such concepts as a slowdown are difficult to apply when speaking of Korolev.

The first launching of a booster with a Zenit space vehicle took place in late 1961. The launching was a failure; due to a shutdown of the third stage of the booster the space vehicle did not enter orbit. The next launching was in April 1962. The satellite was given the official designation Cosmos 4.

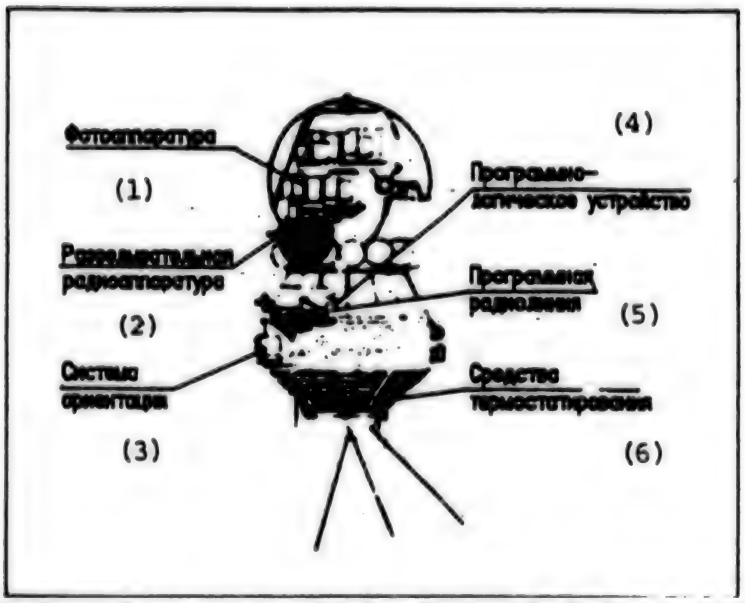
But not everything went perfect on this flight: malfunctions occurred in camera operation and there were errors in the orientation system. Nevertheless, after three days, as was planned, the descent module landed in the stipulated region. Thus began the flight-design tests of the Zenit spy satellite. In 1 ½ months it was possible to eliminate the shortcomings and already in July of that same year a new flight was made during which the on-board systems operated well and the tasks were fully carried out.

Under the program of flight-design tests, which lasted 1 ½ years, ten flights were made. Their duration increased and new operating regimes, control methods, search apparatus and means for evacuating the descent modules were fully developed.

In addition to a camera, the satellite carried special radio surveillance devices transmitting information to the flight control center in communication sessions. Each test flight yielded an enormous volume of information concerning the Earth's surface.

The tenth and last test flight took place in October 1963. Like all preceding launches, it was announced as part of the Cosmos program. Thus, among the 20 satellites which were counted by that time under the Cosmos program, 10 in actuality were secret Zenit satellites. Their launches sometimes took place each month and there were even cases when the next launch took place a day after the landing of the preceding descent module. This high rate of Zenit launchings was maintained even after completion of its flight-design tests.

The results exceeded even the most optimistic expectations of the client. The Zenit became the first space vehicle delivered to the Ministry of Defense for standard operation. Naturally, not only the satellite, but the entire complex supporting its preparation for launching, launching into an artificial earth satellite orbit by means




**Fundamentally new systems and devices developed for Zenit space vehicle.**

Key: 1. camera; 2. Surveillance radio apparatus. 3. Orientation system. 4. Programming-logic device. 5. programmed radio link. 6. Thermostating device.

of a booster, flight control, and search for and servicing of the descent module after its landing, were transferred to the ministry.

**What were the capabilities of the Zenit satellite?**

On each flight it was possible to photograph regions with a total area of more than 10 million $km^2$ (for reference purposes: the area of the United States is 9.36 million $km^2$). In addition, the resolution of the photographs was so high that it made it possible, for example, to determine the number of automobiles in a parking lot.

In order to ensure such capabilities the satellite carried four cameras, three of them having objectives with long focal lengths (F = 1 m), each with a film supply for 1500 frames. The width of the survey band was 180 km. The ensemble of satellite equipment made possible a survey of extended paths in large series. Due to programmed rotations it was possible to photograph regions situated to one side of the flight trajectory and the camera also provided a three-dimensional image of the terrain and made it possible to solve a very complex problem: obtaining a base for mapping many regions and reducing them to a single system.

It is even difficult to compare the capabilities of a spy satellite for obtaining photoinformation with the capabilities of traditional equipment and systems.

A single flight of five to seven days made it possible to do that which aerial photographic surveys would have required years and incommensurably greater expenditures. An aerial photographic survey could not deal with such a task as periodic photographing of large regions for determining trends in changes, as well as surveillance observation of territories located far beyond the boundaries of the USSR.

The reduction of the cartographic base of different continents (and historically it had developed that each of them had its own base) to a unified system was of great importance for solving defense problems, as well as navigation problems. The flights of the first Zenit space vehicles helped in increasing the accuracy in solving this problem.

The camera, raised to an altitude of 200 km or more, made it possible to see global formations and to evaluate the characteristics of large territories (later this came into use in the search for natural resources). Thus, research carried out in the late 1950's and the practical work in developing the Zenit spy satellites in the early 1960's laid the basis for developing the systems for observation of the Earth from space which are used today in solving a broad range of problems.

A draft design for a new spy satellite outfitted with a camera with an objective focal length of a substantially greater size was developed in 1964 at OKB-1. The finalization of this project virtually completed work on the creation of spy satellites at the OKB-1. Already in the stage of flight-design tests this work began to be transferred to one of the OKB-1 affiliates, which beginning in 1963 became involved in this field of space technology and which for many years constituted a major independent organization.

Spy satellites were not the only direction pursued by the OKB-1. The organization headed by Academician S. P. Korolev up to 1963 had a monopoly on constructing

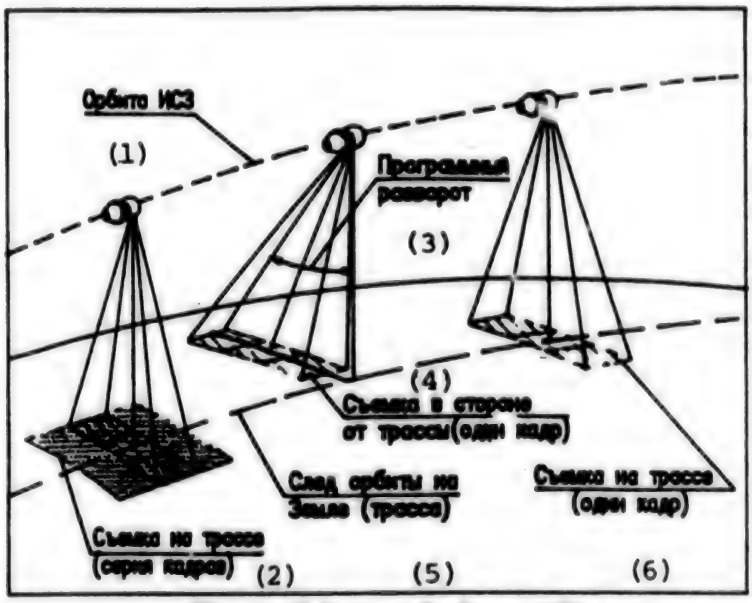



**Diagram of photography from satellite.**

Key: 1. Artificial earth satellite orbit. 2. Survey along trajectory (series of frames). 3. Programmed rotation. 4. Survey to one side of trajectory (one frame). 5. Orbital track on Earth (trajectory). 6. Survey on trajectory (one frame).

space vehicles and boosters. Over a very short period of time the design bureau carried out development work along three strategic paths in the development of cosmonautics, planning and implementation of flights: automatic artificial earth satellites; manned spaceships for flight in near circumterrestrial space; automatic vehicles for flights to the moon and planets of the solar system.

Beginning in 1962, having devised a grandiose program for the development of manned cosmonautics, including manned flight to the Moon and Mars and the creation of large orbital stations, Korolev transferred to other organizations such branches of cosmonautics as use of automatic vehicles for exploration of the moon and planets (Luna, Mars, Venera), surveillance (Zenit), radio communication (Molniya 1), and a number of others. It was not projects, but "living" flying space vehicles, all experience in work on them, experience in flight control and promising development work which were transferred.

For all practical purposes Korolev retained for the OKB-1 the main dream of his life: manned cosmonautics.

The OKB-1 twice changed its name: after the unexpected death of Korolev in 1966—to the Central Design Bureau for Experimental Machine Building (CDBEM), then to the Energiya Scientific Production Association (Energiya NPO). Despite name changes the organization created by Korolev continued the fundamental task which he had envisioned.

Today the Energiya NPO is the leading organization of the country in the field of manned cosmonautics, an enterprise with the very highest reputation, known throughout the world, headed by the General Designer Yu. P. Semenov.

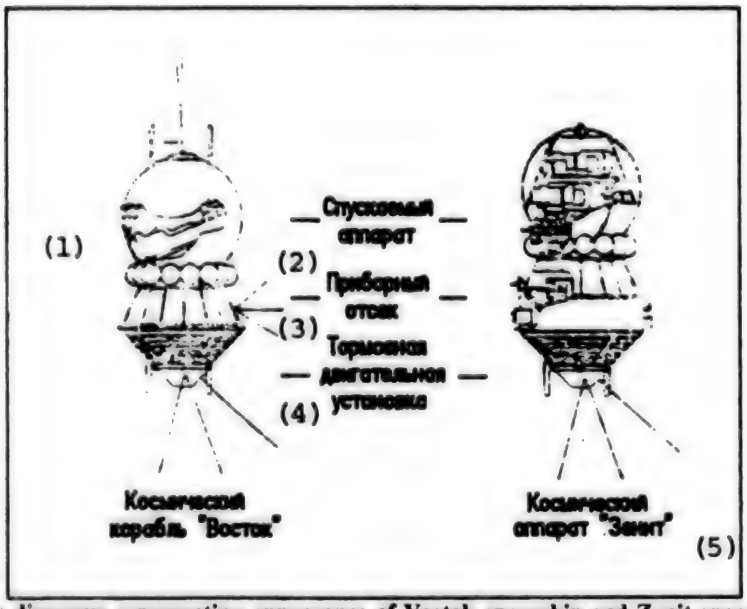
**Features of Design Development Work**

The development work on the spy satellite made it necessary to solve a number of fundamental scientific and technical problems.

The initial stage, especially everything related to the complex of problems related to photoinformation, proved to be very difficult. Reference is to high-quality photoinformation with the identification of objects measuring about 10-15 m. Then the principal difficulties were, first of all, an evaluation of the fundamental possibility of obtaining such information and determining the specifications necessary for such cameras, and second, checking on whether it was possible to create aboard a space vehicle the conditions necessary for their functioning.

In order to obtain a high-resolution photoimage from a flight vehicle which is moving at a velocity of about 8000 m/s at altitudes 200-400 km it was necessary to formulate the theoretical principles for designing and constructing optical systems with long-focus objectives and large multilayer lenses.

It also was necessary to overcome other obstacles. For example, in the course of exposure the film had to move at a rate seemingly making it possible to freeze the terrain image. This process is called image displacement compensation. Photograph quality and resolution can be ensured only in a case when the deviations from the




**Design diagrams representing appearance of Vostok spaceship and Zenit space vehicle.**

Key: 1. Vostok spaceship. 2. Descent module. 3. Instrument compartment. 4. Braking engine. 5. Zenit space vehicle.

stipulated rate of compensatory film movement do not result in a displacement of the "frozen" image by more than 0.01 mm. This can be attained under the following conditions: if, first of all, the altitude of the survey, the velocity of space vehicle motion and its angular position in space at the time of the photography are known with a high accuracy, and second, if the stipulated rate of film movement in the camera itself is precisely ensured. It was found that both conditions can be satisfied.

Without delving into the mechanism of the influence of temperature on the quality of the resulting photoimage, we will cite some requirements on the space vehicle heat regulation system. In order to obtain photographs of the necessary resolution, the temperature of the objective and the camera itself must be maintained with a deviation from the stipulated value of less than 1°C and the rate of its change must fall in the range about 0.1°C per hour. In addition, it must be taken into account that in the course of flight the spacecraft is oriented differently relative to the sun and this means that the external heat flows change substantially, especially with allowance for the "setting" of the space vehicle in the Earth's shadow.

The port, being a component of the objective, aggravates the problem of maintaining the thermal regime because an insignificant temperature difference in the glass layers of the port changes their curvature, which in optical systems with a long focal length is significantly reflected in image quality.

These examples only partially reflect the scale of the difficulties. The problems involved in creating the ensemble of space vehicle systems ensuring control of its motion and programmed control of its camera must be particularly mentioned. These systems did not have analogues in preceding development work. The first system had to maintain prolonged triaxial orientation in an orbital coordinate system during virtually the entire orbital flight. With such an orientation one of the axes is directed toward the Earth and the other in the direction of vehicle motion. A very high requirement on the accuracy in orientation of the axes was imposed on this system due to the fact that an uncompensated orientation error, exceeding the limit of one degree, is destructive for the quality of the registered image.

Special gyroscopic transducers were used for the first time in the orientation system for a spy satellite and regimes of transducers for constructing the infrared vertical and a number of other system elements were fully developed.

A quite complex problem was that of control of the camera outfit from the ground. In comparison with preceding development work, when control was by one-time commands (starting-stopping of the system or a system element) and "settings" (stipulated numerical value for a limited number of parameters), the volume of information which it was necessary to transmit to a ship was increased by more than an order of magnitude. This applies, in particular, to a large number of complex programs for adjusting each photographic session.

A programmed radio link and an on-board programming-logic unit coupled to it were developed for the first time for the Zenit satellite. This was the prototype of the space radio systems now in use, intended for the

exchange of considerable volumes of information between a space vehicle and the complex of apparatus at the flight control center.

Satellite variants of different size, with a mass from 1.5 to 4.5 tons, were considered during the course of design work. Already in an early stage, from considerations related to efficiency, preference was given to a heavy satellite with a mass close to the limiting weight.

The choice of external appearance of the satellite was characteristic for the Chief Designer. If at some exhibit somewhere the two space vehicles—the widely known Vostok and the Zenit, which has never been put on display—were put side by side, the visitors, without glancing inside the compartments, most likely would not see the difference.

Is this similarity accidental? The similarity of two space vehicles differing fundamentally with respect to purpose, makeup of instrumentation, programs and flight control, one of which was a manned spaceship and the other an automatic spy satellite? No, not at all!

Up to a definite time the layout of the Zenit had nothing in common with the external appearance of the Vostok, the basis for which was a spherical descent module and an instrument compartment, consisting, seemingly, of cones with their bases put together. The Zenit, according to the preliminary development work, also had two compartments, but not at all of this configuration and size: a large cylindrical instrument compartment and a small conical capsule with cassettes into which the exposed film is wound. Only the capsule was returned to the ground from orbit.

In 1958 Korolev made another decision. The design of the Vostok manned ship, which was being developed actively at that time, was adopted for the spy satellite. The variant was complex for camera installation, but made it possible to avoid many new problems, including finalization of a descent module-capsule in its geometry differing substantially from that adopted for the Vostok. This decision greatly reduced the time of appearance of the Zenit and substantially increased its in-flight reliability since there already existed the experience for a manned ship on which special, exceptionally high requirements on ensuring safety had been imposed.

The creation of the Zenit satellite, beginning with thorough research and ending with the transfer to the client of reliably functioning apparatus for standard operation, was valuable experience later applied and developed in major space projects.

Today it is difficult to believe that only five years passed from the launching of the world's first satellite to solution of a complex of problems related to the use of space vehicles for collecting high- resolution photoinformation.

**Cosmos Program**

The "Cosmonautics" encyclopedia gives the following definition of the Cosmos program: "The program for launchings of the Cosmos artificial earth satellites includes research on cosmic rays, the Earth's radiation belt, ionosphere, solar activity, testing and finalization of space vehicle units, study of the influence of weightlessness and other cosmic factors on biological objects, etc." Selected data also are given on the launchings of some space vehicles.

Specialists involved in space technology know that in the Cosmos program, in addition to those mentioned in the encyclopedia, there were major unannounced directions, series of satellites and entire space systems of satellites.

Many questions arise with respect to the essence of the Cosmos program, which now has already continued for 30 years. Meanwhile its strategic directions and goals have not been spelled out in open publications, the stages in its realization and its results have not been defined.

Many questions also arise about the relationship between the Cosmos program and other space programs of the country. These include the programs for the manned spaceships Vostok, Voskhod and Soyuz, the Salyut and Mir orbital stations, as well as the programs for use of automatic vehicles for scientific research (Electron, Luna, Mars, Venera, and others), for ensuring radio communication (Molniya, Ekran, Gorizont, and others), weather prediction (Meteor), and many others.

Evidently secrets are inevitable in new research. It is possible to explain the secret nature of a number of Soviet and American space programs during different periods of history, especially during the cold war period. It may be that even today some of the programs and development work should be stamped secret, but secrecy is an enemy of progress and everything which is not a state or commercial secret should be made public. In our day conditions without question make possible and obligatory, in order to generate an atmosphere of trust, the removal of the secrecy stamp from many directions in the development of space technology, especially if the matter pertains to events occurring several decades ago.

In addition to the spy satellite, the Cosmos program includes satellites for warning of a missile attack, satellites for marine reconnaissance and other space vehicles.

For different reasons the Cosmos program also included nonmilitary satellites, for example, a number of OKB-1 manned ship developments, automatic lunar and interplanetary stations.

Due to "secrecy" considerations this program included those lunar and interplanetary automatic vehicles which due to the failure of the last booster stage were not put into a flight trajectory to the moon or a planet and remained in the Earth's orbit. For this same reason the completed unmanned launchings of some of the ships of the Soviet lunar expedition also were included in the

Cosmos program, naturally without an announcement of the purposes and results of the flights.

It must be noted that as of today there have been few publications concerning the history of development of the N1-L3 rocket-space lunar expeditionary complex in the USSR. This can evidently be attributed to the fact that work on the complex was not completed by flights to the moon.

The Soviet expedition did not take place and the subject was put under wraps. It was made secret when the American Saturn-Apollo program, in whose implementation human beings for the first time landed on the moon, was successfully completed. The history of development of lunar automatic vehicles, the designing and finalization of the lunar N1-L3 lunar expeditionary complex and promising research directed to study and use of the moon, must be the subject of an individual serious article or series of articles, from which readers could draw facts and data on the principal directions in development work, as well as the specifications of the technical apparatus of the complexes.

Today it can be said with assurance that the grandiose Cosmos program, announced in 1962, to a considerable degree represents the artificial bringing together of different directions, poorly related to one another, information on which contains many blanks. Without eliminating these gaps it is impossible to understand and correctly evaluate even the initial stage in the development of cosmonautics.

What can be learned from the half-opened page in the history of cosmonautics—one of the fragments of the mysterious Cosmos program? Two conclusions suggest themselves.

First, even a brief "biography" of the Zenit spy satellite confirms the already mentioned truth that secrecy in science, engineering and technology is a harmful phenomenon.

The second conclusion applies to the situation which is unfolding today. The more than 30 years of management of space programs, analysis of the history of their formulation and development, show that our country has unique bodies of scientists and specialists in the field of development work on problems related to cosmonautics and the creation of space vehicles.

This branch, in contrast to others, even in our day is at the highest level, but in some directions, such as in the field of mastery of prolonged manned flights and the operation of orbital complexes, has a worldwide recognized priority. Cosmonautics has recently been subjected to serious criticism. A number of these points of criticism are correct, others are doubtful, but some, unquestionably, are out and out misguided.

The points of view may be different, but actions must not result in the collapse of scientific centers and enterprises. Cosmonautics is a national resource of the country.

## Security Issue Raised Over Sale of Military Space Systems

### Sale of Military Space Commo Systems Said To Damage Russian Security

*937Q0168A Moscow NEZAVISIMAYA GAZETA in Russian 30 Jun 93 pp 1,2*

[Article by A. Nadzharov, under the rubric "Scandal": "Something Is Not Right in Space: Businessmen in Generals' Jackets Have Reached Russia's Space Troops, Too"]

[Text] The pulse of energy sent out by the top-secret, state-of-the-art equipment pierced outer space and, via an intel communications satellite of the Russian space-defense units, reached the United States in a fraction of a second. An electronic decoder instantly translated into English the text that a gentleman in civilian clothes had been anxiously awaiting. Running his eyes through the lines containing designations of frequencies and other secret parameters of the transmission, he read: "The blue bed pans have been received, the money has been sent. I await a new batch. Col. Gen. I."

No, that wasn't a supercode of the Russian military intelligence, and the Russian name wasn't a pseudonym for any sort of modern-day Shtirlits. Despite that, though, at the CIA, they couldn't believe it for a long time that an ordinary business message had been transmitted with Soviet space communications systems that until only recently had been guarded in the strictest fashion.

By the way, I can't vouch for the complete authenticity of that particular bed-pan text. But still, don't be too quick to regard the above as merely journalistic hyperbole: the safe at the editorial offices contains copies of business telegrams cleaner than that. They all traverse the reaches of outer space regularly with the approval of the commander of the Russian space-defense units, Col. Gen. Ivanov, which unequivocally testifies to the transformation of one of the highest-positioned leaders of our army into a banal shopkeeper. By the way, he's not the only one in that sense. The agreement on the commercial use of the secret military communications satellite was signed by him and two other generals—an industry general and a general from the military intelligence. And that was done after the order by the defense minister, who categorically forbade commercial activity in the army and especially in space communications.

We'll return to the question of the nature of the use of secret communications later, but for now we'll try to figure out just how the words "commerce" and "commander-in-chief of space units" came to be synonyms.

A little over two years ago, a group of American and then-Soviet entrepreneurs decided to organize a commercial space flight from Plesetsk Cosmodrome to Seattle. The idea, one must admit, was wonderful: samples of the goods that the two great powers could trade were placed into the space shuttle craft. Just think what an advertisement that was! In the meantime, not all the hopes on that score came true, although it was not at all the fault of the organizers of the flight. As so often happens with us, unfortunately, practically all the steam went into nothing but the whistle. And the steam represents some fairly large preliminary outlays. What were they? Mainly appropriations for the general's continually growing needs associated with humoring those on whom, frankly, the possibility of the space flight itself depended. Plesetsk, I remind you, is a military cosmodrome. And whom among us are the space units subordinate to? Right, Col. Gen. Ivanov. Here Vladimir Leontyevich [Ivanov] and his spouse are sailing on a luxury liner across the ocean. And over there is an unforgettable trip around America: expensive hotels, restaurants, and stores. And, of course, he didn't pick up the tab for any of that, and fortunately, neither did the defense budget. The American and Russian business firms picked it up.

If that had happened with an American general, he would've been sent right away to something very different from the family ranch for that. Vladimir Leontyevich merely sped up the pace greatly of the organization of his own fazenda near Moscow. It's a good thing, and here's why: at one time, he personally headed the commercial firm Kosma, thereby proving that skillful management in stripes [a military man] is capable of privatizing even outer space. Or at least the principal operations in space.

Serving out a fairly large term somewhere in the provinces, as they say, not so far away, is one of my colleagues, who sold American intelligence the address of a modest home near Kursk Station—23 Kazakov Street. Operating very, very fruitfully there before, as well as after, his betrayal were two directorates of the Ministry of Defense that are responsible for all of manned space, as well as for protection against SDI and other space weaponry. Now they're not operating. Friends of Ivanov—retired generals—are preparing to move there, to continue turning the dizzying currency deals involving space services to foreign clients. Those deals involve navigation, communications, photography, and trade-brokering. But since all that is being done at the command of the disinterested Ivanov by the space units entrusted to him, a truly commercial firm is not quite regarded as commercial. At any rate, the lease for the magnificent building, which at one time belonged to the lover of Savva Morozov, is being paid for out of the Ministry of Defense budget, and at a rate that (to the attention of the capital's mayor!) other entrepreneurs couldn't even dream of getting. Restoration is being finished there, a unique parquet floor is being laid, mirrored windows are being installed. And how could it be otherwise: after all, instead of the mercantile flame, there in the expansive apartments, with a recreation room, a reception room, a kitchen, and a private restroom, is the commander-in-chief himself. Well, of course, it's his personal business service.

I can see a reproach coming: the writer is trying to resurrect the image of an enemy. And I say, Yes, I am trying. But not at all in the form of our foreign partners, who have spent a good deal of effort and money to support reform in Russia. But, you say, how can we be with, say, the American military intelligence? It's better for us if it's a friend now, right? Well, if that's so, then why is it that in the criminal codes of absolutely every other country in the world, including the United States, there is a statute that provides punishment for helping the intelligence community of another government?

And there is just such a statute in the criminal codes of the Russian Federation. But where was the prosecutor when the Americans (who consisted of not just businessmen, unfortunately) were invited to visit the command center of the space-defense units? By the way, to this day, not even all our generals have been allowed there. So, after visiting the top-secret command center and, in the Academy of Sciences, carefully looking over a high-energy laser that was designed to destroy enemy satellites and that amazed the Americans, one of the foreign guests openly said this: "The Russian openness is simply astonishing." That phrase, as they say, was replete with meaning, especially after the surveys of the active board with top-secret data.

It's too bad that the agencies for protecting rights are already tired of being astonished at what is taking place in Ivanov's department. Because then the reporter-traitor and the space general could trade places. By the way, the bureaucratic machine in place for the army mutual protection would hardly leave its best representatives in the lurch. If they ever go on trial, they will probably submit to it evidence of the fact that all their actions were coordinated with the chief. Or, just the opposite, they'll try to hide any compromising documents. For example, telegrams that voice the requirement to, in accordance with the orders of Commander-in-chief Ivanov, devote time to setting up commercial communications between the relay station in Shchelkova (in Moscow Oblast), the military satellite Altair, and a point with the coordinates of 38°47 min N lat and 77°09 min W long. For those who aren't very familiar with the geography, that's the location of the U.S. capital, Washington.

And so now the time has come to talk about the actual circumstances facilitating what happens at other times in the army. In a recent conversation with this writer, Russian Minister of Defense Pavel Grachev noted that, because of political cataclysms, the army, for a number of years right up to the beginning of last year, had essentially not had combat maneuvers. Recall the first few months after the August putsch. Anybody in a military overcoat was looked down on, was insulted, and he avoided putting on that very overcoat so as to avoid

the sneers and even worse. But few know of one particular form of humiliation—the cynical "recommendation" made by other Yazov generals to sell everything that can be sold, because the wages are so low. Pavel Grachev, to give him his due, straightened things out rather quickly by forbidding commercial activity in the army, winning decent pay from authorities, and ridding the army of a good many of the plunderers in shoulder boards. But then our ever-forming state machine threw a wrench in the works. But the swindlers in striped pants, despite the obviousness of their deeds, were not brought to trial for some reason. So, they got off easy—retirement, admission to hospitals, etc.

Now on that soil, densely fertilized with corruption, the next scandal is maturing. At the order of Commander-in-chief Ivanov, who is truly indefatigable in his commercial activity, one of the military-space communications channels has been sold to a foreign buyer. Not just secret communications, but top-secret communications. Specialists know what that means, and they're not hiding their indignation. It turns out that that means that what is sold abroad are the communications protocols, the transmission frequencies, and the capabilities for deciphering codes and all kinds of manipulations that are made with Russian ground-based computer complexes. In a word, things that dozens of our closed research institutes worked on for many years and to which foreign intelligence communities had no access, much to their chagrin. There wasn't any proper equipment to access it. Just the military communications satellites Geyzer and Altair alone, along with their support systems, cost our taxpayers trillions in today's prices.

But would that the problem were confined just to mind-boggling sums. Our businessmen and their foreign partners can now find any source of radio transmissions, even the ultra-high-frequency sources. And generally selectively affect the operation of Russia's space-based communications system. Just imagine if all of a sudden one of them decides that messages transmitted "through" the Russian ministries of security, foreign intelligence, and diplomatic service are not important. And would it be good if the messages of those departments are interrupted by an urgent dispatch with an order for blue bed pans? No SOS transmitted even in the most urgent situation would get through.

Right now, it's not going to the rights-protecting agencies. Specifically, because all documents associated with the commander-in-chief's machinations are stamped "Secret" or "Top Secret." So the only department that can remove those stamps is, according to Russian law, the department that put the stamps on in the first place. That is, the Directorate of Space Forces and General Ivanov himself. It's doubtful that he will open his business archives to the legal community.

In the opinion of specialists of the military counterintelligence who came to the newspaper, the situation requires an immediate investigation by a special presidential commission. In the meantime, General Ivanov in the next few days will probably try to somehow justify his actions to Boris Yeltsin, in whose suite he is getting ready to go to Baykonur for the launch of the next joint crew into space. They say the president is strict, but easily appeased.

## Space Managers Call Security Issue 'Disinformation'

*937Q0168B Moscow NEZAVISIMAYA GAZETA in Russian 30 Jul 93 p 8*

[Article consists of letter written by General Designer D. Kozlov, General Designer M. Reshetnev, General Designer G. Guskov, General Director L. Gusev, and General Director A. Kiselev, in response to Nadzharov article: "There's a Question, But No Answer"]

[Text] The space sector of industry, like all the rest of the Russian economy, is going through tough times: cooperative ties with nearby countries have been disrupted, and the funding for experimental-design work and for the series production of rocket-space equipment has been cut considerably. A number of enterprises have stopped manufacturing products for lack of money. In those conditions, the only way out in the battle to save the sector is seen in the attraction of extrabudgetary monies and in the conversion-related use of rocket-space equipment manufactured or developed in the context of orders placed by the Ministry of Defense. That is supported by the Supreme Soviet and the president and government of the Russian Federation.

Which is all the more reason for the surprise evoked by the 30 June 1993 article in NEZAVISIMAYA GAZETA by A. Nadzharov—"Something Is Not Right in Space."

The representatives of the mass media are, by and large, better informed than other people about the role and the necessity of state-of-the-art telecommunications systems in the performance of their own professional duty. The integration of our country into the world cultural and economic community would also be unthinkable without telecommunications. That is exactly why in 1990, a government regulation called for sector enterprises to do work to create a commercial satellite telephonic communications link between the USSR and the United States via the Geyzer relay satellite. That made it possible to develop and begin manufacturing in our country ground communications equipment to support the functioning of the communications link. Thus, the important task of getting our high-tech products, and not just raw materials, out into the world marketplace is being resolved, and the capabilities of the Geyzer satellites—a description of whose relay gear has been properly registered with the International Telecommunications Union [Mezhdunarodnyy soyuz elektrosvyazi] are being used more fully. The money received from the project goes to supporting production and maintaining the social security of the sector's workers.

Expressions like "intel communications satellite," "top-secret, state-of-the-art equipment," and "line containing

designations of frequencies and other secret parameters of the transmission" evoke among specialists not only surprise at the illiteracy of the writer, but also indignation at how such disinformation can appear on the pages of this respected newspaper.

Another "military" satellite, Altair is intended for transferring television and support-program information between the orbital Mir station and the Flight Control Center via the "relay station in Shchelkova" mentioned in the article. The situation with the "secrets" and other "accusations" involving the expansion of the sphere of use of the Altair satellite is similar to the situation with the Geyzer satellite, and that relay satellite is used only for carrying out the experimental program involving the provision of remote medical support in the context of an intergovernmental agreement on space and for the benefit of the international medical community, especially in such realms as manned space flight and natural and industrial disasters. It is in the context of that program that the experimental radio link is being perfected for transmitting television information between the Ostankino television center and the international teleport in the city of Washington, where equipment developed and manufactured in our enterprises has been sent. That is yet another source of extrabudgetary funding of the sector.

And finally, about the space flight between Plesetsk and Seattle. That was a practical confirmation of the capabilities of our rocket-space equipment in handling any task placed before it. And not one copeck of stage money was invested in that project; the entire project was financed by Russian commercial firms.

The entire group of Russian industry and military-department specialists who helped effect that project received an invitation from the American side in connection with the 500th anniversary of the discovery of America and the successful completion of the space experiment.

What was the writer's objective?

To plant seeds of doubt among the readers with respect to the need for Russia to carry out space programs, to set up a mutually beneficial collaboration with other countries, to develop satellite information systems built on domestic achievements?

To make an additional contribution of questionable character to an already difficult situation in the space sector?

To disorient public opinion with respect to our space program and its military arm?

We don't have the answer. But there should be one.

[Comment "from NEZAVISIMAYA GAZETA"]

Without entering into an argument with the writers of this letter, we report that, according to our information, several commissions from different departments, including the military procurator's office, are now at work as a result of the article they referred to. We will report the results of those investigations to our readers.

### Continuing Problems of Baykonur Cosmodrome

*937Q0181A Moscow ROSSIYSKIYE VESTI in Russian No 128, 7 Jul 93 p 7*

[Article by Vadim Chernobrov: "Drama of the Cosmodrome"]

[Text] The launching of the Soyuz TM-17 spaceship was in doubt up to the last moment. The booster was received at the cosmodrome with an enormous delay and in order to meet the schedule the workers did not leave the assembly-test building around-the-clock. And we will familiarize you with the results of this rush work...

Leninsk wakes up early, and on days of launchings, still earlier. On the city buses and then on the motorbus (a hybrid of electric and thermal power) it takes 2 hours to creep across the scorched red semidesert before the merciless sun becomes the sole master of this Martian landscape. However, everything here has its deep meaning. In order to create a rocket test site in 1955 a large area of waterless land, not needed by anyone, was specially selected as close to the equator as possible and as far from the sea as possible so that it would be sunny 300 days a year. And the fact that the cosmodrome launch pads had to be 30 km apart—as dictated by cold war requirements—since even after a nuclear explosion at one launch pad the adjacent pads had to remain intact.

The "star harbor" was, in essence, a large military city with a population of 100 000, where absolutely everything was decided by the chief of staff of the military-space forces. Any patrol had the right to detain even an old woman discarding rubbish in an unauthorized place and to establish her identity for subsequent disciplining of her officer-son.

"It is a different matter now," laughs Major Igor Perekhvat, "totalitarian control methods from the beginning of restructuring became a matter of the past, and together with them, also at least relative order. The city is in a frightful sanitary state and nothing safeguards us from outbreaks of epidemics."

"Among all the changes during the past years at the cosmodrome only one stands out on the good side," says Lt. Col. Yaroslav Nechesa, chief of the press center, who joins the conversation, "the housing problem has completely disappeared. And why is this so? About half of the specialists have already departed for Russia! There are no wages, there are no prospects and no one knows what awaits our people after a month or two..."

In actuality, in Leninsk, which earlier with good reason was called the city of lieutenants and young mothers, it is virtually impossible to encounter pregnant women. The cosmodrome is rapidly aging and most of the service has been taken over by senior officers, those who have put in

their time. During the last two years only ten young lieutenants risked going to Baykonur, which is approximately 200 times fewer than the former norm.

The holy place will not be empty... In the city, after the departure of many families of military personnel from it, the abandoned apartments were occupied by people not having any relationship to the cosmodrome and engaged in speculation, drunkenness, drug addiction and hooliganism.

V. Brykin, the head of the local administration, correctly regards the main reason for all the misfortunes of Leninsk to be the acute insufficiency of financing. Russia and Kazakhstan, agreeing to allocate for Baykonur in 1993 first 32 and then 38 billion rubles and the necessary number of soldiers finishing out their enlistments, in actuality are not meeting their obligations. In the opinion of Yuriy Koptev, who heads the Russian Space Agency, the initial plan—for the cosmodrome to be given the status of a "Russian military base in Kazakh territory"—was doomed to failure. "All the land around belonged to our forefathers" is a difficult argument to refute.

However, the desire of the owners of the territory to subordinate the highly complex economy of the test site completely to themselves also is entirely unrealistic because both the specialists and the space plants and the tracking stations belong to Russia.

It is not just in Alma-Ata that the thought has been expressed that it wouldn't be a bad idea to allow Western specialists with their own rockets at the privatized cosmodrome; in Moscow Pavel Grachev, the Minister of Defense, reminded everyone that the second stages of any rockets launched in Kazakhstan would still fall in our country in the Altay. Moreover, Russia cannot blithely simply abandon Baykonur and transfer its main attention to Kapustin Yar and Plesetsk because only in the Kazakh steppe are there launch pads for heavy rockets of the Proton and Energiya types.

Oleg Nikolayevich Soskovets, the first deputy chairman of the Council of Ministers of the Russian Federation, arrived in Leninsk in search of mutually acceptable compromises. "The time when many played at sovereignty has disappeared into the past, never to return," he declared at the very beginning of a meeting with his Kazakh colleagues, "and our (and your!) national pride can be saved only by joint efforts." The promise given by Oleg Nikolayevich while still in Moscow not to leave Leninsk until the agreement has been signed has been kept.

The agreement on the mutual buildup of the Russian forces located in the territory of Kazakhstan includes an obligation of Kazakhstan already in the course of this month to send to the extremely thinned-out forces 6000 conscriptees (including 1500 to Baykonur). Permission was granted for the admission of more than 20 000 soldiers from Russia; in exchange Kazakhstan, already in the autumn, will be able to send 500 of its students to Russian educational institutions.

In the future the cosmodrome itself will evidently be transformed into the Baykonur joint stock company. The first steps in this direction have already been taken. The Energiya M and Proton joint stock companies have been organized with the participation of the Kazakh side in each of them in the form of the Leninsk administration.

### Baykonur Situation Seen as Test Case for Achieving Necessary Economic Stability

*937Q0177A Moscow POISK in Russian No 28, 16-22 Jul 93 p 3*

[Article by Sergey Leskov, Baykonur, Kazakhstan: "Life at the Dying Cosmodrome"]

[Text] Several weeks ago the dismembered corpse of a 14-year-old boy was found amidst the brightness of day on the city beach at Leninsk, the administrative center of the Baykonur cosmodrome. Leninsk, in the wretched and backward USSR, always was regarded as an oasis of a calm and relatively secure life. But, strange as it may seem, the bloody occurrence on the banks of the Amudarya did not very much excite the residents. Such changes have occurred during the last year in the life of Leninsk that holdups, thefts from apartments and drug addiction are perceived as something commonplace. Over a year's time 21 000 people have departed from the flourishing city, more than a quarter of the population. The extinction of Leninsk and the Baykonur cosmodrome is profoundly associated not only with the political and economic problems of the CIS, but also with the attempts of Russia to strengthen itself in the world community. It is difficult to find a brighter example characterizing the present state of the former USSR.

On 1 July a Russian-French crew was sent into space for three weeks. This was already the fourth joint flight of the cosmonauts of the two countries and the experiments prepared for this expedition continue the already established direction. For these reasons the flight, as indicated by the reaction of the press, did not become a sensation in either Russia or in France.

And nevertheless some circumstances make the flight of the French cosmonaut in a Russian ship a noteworthy event going far beyond the framework of cooperation of the two countries in the cosmonautics field. The present international expedition was the first for Russia after the breakup of the USSR. Although the international crew was launched from the familiar Baykonur cosmodrome, it also for the first time was juridically reckoned as the property of sovereign Kazakhstan. Without exaggeration it can be said that changes in the structure of Soviet cosmonautics are not a matter of indifference for the entire world community.

In the technically backward USSR cosmonautics was that small island in which the best advances in science

and technology were concentrated and in which enormous material and intellectual resources were invested. It is not surprising that the chances of Russia to be integrated into the international economy and to capture a solid place in the world market are most realistic precisely in the cosmonautics field.

This also is favored by the situation developing in world cosmonautics in which a number of American and European programs have entered a blind alley and can be reanimated by cooperation with Russia.

The European community and the Russian Space Agency have prepared documents on the allocation of 12 commercial launchings to Russia during the period 1996-2000. The possibilities of using Russian technologies and launching complexes for the orbital station Freedom, which the United States, the European countries and Japan are creating, are being actively discussed. The joining of Russia to this project may bring 500-600 million dollars into the slender Russian treasury and maximum estimates exceed 1.5 billion dollars. In the United States and Russia preparations already are being made for joint flights of the cosmonauts of the two countries. Need it be mentioned how important direct receipts of foreign exchange are for the Russian treasury? Incidentally, Russia today does not have any other projects related to technological exchange with the West.

Reliable Russian rockets for the launching of satellites into orbit are being proposed not only to the West, but also to the entire world. But many difficulties are involved here. Most of the satellites are fabricated using American technology. In order that they be brought into Russia it is necessary to obtain an export license in the United States. For the time being almost every such contract must be accompanied by a political decision at the highest level. So it happened, for example, in the past year when Yeltsin and Bush signed a contract for launching of the INMARSAT satellite.

The United States held a rigid position, linking access of Russia to the space services market to its adherence to the agreement on the nonproliferation of rocket technology. A contract signed by Russia and India on cooperation in constructing a cryogenic hydrogen stage for a national Indian booster is causing especially many debates. The United States, formally protesting this contract, is right: the technical specifications of the rocket go beyond the framework established by the agreement. But, on the other hand, this class of rockets for technical reasons to all intents and purposes cannot be used for military purposes.

This conflict became the reason for postponement of the recent visit of prime minister V. Chernomyrdin to the United States. It would seem that it would be simpler for Russia, in anticipation of considerably larger Western orders, to sacrifice the contract with India, whose amount was considerably less—120 million dollars. But the abrogation of the contract would have a bad effect on the business reputation of Russia: it would reinforce its reputation as an unreliable, unpredictable partner, dependent on the wishes of the West. But India, after all, is a leader of the third world, and its voice is being heard here.

The episode with cryogenic engines illustrates those problems which the countries of the "Big Seven" are discussing at a meeting in Tokyo. Russia is attempting to enter into the world community as a partner with equal rights, but at every step meets with various discriminatory restrictions which the West had already established in the era of opposition to the Communist regime. According to an estimate by Aleksandr Shokhin, deputy chairman of the government of Russia, should these restrictions be removed it would be possible to expect an increase in export receipts by 5-6 billion dollars already by the mid-1990's. The first place among the promising directions is the entry of Russia into the world market of commercial services in the cosmonautics field.

However, even the good will of the West and the establishment of the most propitious regime for Russia still do not guarantee it commercial success. Everything may collapse due to internal problems. The calamitous, truly horrible situation which now prevails at the Baykonur cosmodrome is not a favorable advertisement for it. There for the second year in a row bloody mutinies of soldiers have flared up in which drunken and brutalized crowds have burned barracks and headquarters buildings. Property is being plundered there—even underground cable. Since Russia does not want to finance the property of another state, the construction of new structures has ceased there and old structures, under the severe climatic conditions, are rapidly falling into neglect.

The roof of the assembly building where the rocket was prepared for the launching of the French cosmonaut has deteriorated so badly that if it rained streams of water would pour down on the spaceship. One of the walls of this building has settled and the main concern of the personnel has been to conceal it from the eyes of French journalists and tourists. An hour before the launching the electricity failed at the launching complex and after the launching the entire city was plunged into darkness. With such a state of technical facilities it is scarcely possible to count seriously on major foreign orders.

If the leaders of the states of the former USSR cannot achieve political stability on a high-priority basis and cannot solve intergovernmental problems, any thought of broad economic cooperation with the West is inconceivable. The matter of solution of the juridical status of the Baykonur cosmodrome by Russia and Kazakhstan should become a touchstone in the solution of internal problems. Unfortunately, among many at the cosmodrome the impression has developed that the leaders are excessively involved in fruitless political battles and are forgetting the real issues. One of the cosmodrome veterans said to me: "I am sure that the launching of the Buran spaceplane is more important for the reputation of Russia than the referendum."

Vitaliy Brynkin, who heads the Leninsk administration, acknowledged that the local police could not find clues in order to solve the killing of the young boy on the city beach. And this is not surprising since despite a standard roster of 320 policemen during the last year the number of police has dropped to 120. The energies of the local law enforcement agencies have been directed, under different pretexts, to "squeezing out" graft from the only joint enterprise in the city which is attempting to organize profitable international tourism.

At the cosmonaut airport I saw how women with infants in their arms almost stormed a military transport plane where there were not even places to sit down. People are abandoning this place forever. If the politicians cannot create conditions for a normal life for them the country will be forced to vegetate at the roadside of the world economy.

## Commercial Use of Russian Military Satellites Criticized

*937Q0187A Moscow MOSKOVSKIYE NOVOSTI in Russian No 29, 18 Jul 93 p A2*

[Article by Yekaterina Glebova; the first paragraph is an introduction]

[Text] Soon after Pavel Grachev, Russian Defense Minister, signed a decree banning commercial activity in the army and especially in space communications, the head of the space forces, Colonel General Vladimir Ivanov, went right ahead with business.

NEZAVIZIMAYA GAZET (NG) of 30 June 1993 published material on the commercial use of satellites of the Altair and Geyzer military control system. Permission for such use of the satellites was signed by Vladimir Ivanov, head of the space forces. In the opinion of NG, Washington now has the possibility not only for receiving a commercial order for a wash basin without delay, but also has access to the technical documentation for the satellite: communication protocols, transmission frequencies, code deciphering...

However, the space generals decided not to limit themselves to this. MOSKOVSKIYE NOVOSTI recently came into possession of still another document giving evidence that the commercial possibilities of space are truly unlimited, the same as the commercial opportunities of Russian generals.

On 25 September 1992 several highly placed individuals, both military and civilian, adopted and signed a "Resolution on Establishing the Ostankino Technical Center-Washington International Teleport Radio Link Using the Luch Space Vehicle." A little earlier, in July 1992, a "Resolution on Use of the Luch Space Complex in the Interests of Solving Problems Not Provided for in the Tactical-Technical Mission" was published. In other words, these objectives essentially involve the transmission of TV information via the Ostankino Technical Center to the Washington international teleport. The list of signatures on both documents starts with the flourish of Colonel General Vladimir Ivanov, head of the space forces. A commercial company from Krasnoyarsk, Merkuriy LTD, whose president is Mikhail Reshetnev, General Designer of Space Communication Vehicles, is an intermediary between the military and civilian "companies." Section 6 of the "Resolution...," signed by the generals, obliges Merkuriy LTD to draw up an agreement on the services of military units providing for, in particular, the "maintenance of personnel directly participating in and supporting space vehicle control." It remains to add that in this business of the generals space military units and systems over the entire territory of Russia and above it are participants.

According to Section 2 of the "Resolution..." America will each day receive not less than four satellite communication hours. The monthly dividend will be millions of American dollars. A legitimate question arises: first, who will receive this money, and second, will the state receive even a cent? The fact is that the military services do not pay taxes. But the costs are paid for by the Ministry of Defense, that is, in the last analysis, by the taxpayers.

It goes without saying that the "space command" states in documents that the secret satellite and surface systems for the entire country will be used only in the time free from their main work. However, according to data provided by military experts a minimum of several hours is required for recalculating the program and readjusting space vehicles for performing their principal mission, that is, for directly carrying out their military objectives. But now visualize situation "X" and the futile attempts of the Flight Control Center to communicate with an orbital station... Or attempts of the Ministers of Defense and Public Security to send an order to their units... What department will then receive the profit?

## Russian Institute Gains Contract for Ariane-5 Rescue System

*937Q0187B Moscow MOSKOVSKIYE NOVOSTI in Russian No 29, 18 Jul 93 p B7*

[Aleksandr Borodulin: "Russian Parachutes Will Save the 'Ariane-5.' Contract Awarded in Preference to British and Americans Affords This Right"]

[Text] The European Space Agency (ESA), developing the new-generation Ariane-5 booster, has called upon a national defense enterprise for work on the development of rescue systems. The two-year contract signed in Moscow between the Parachute Making Scientific Research Institute, the Spanish Simsa Company and the Dutch Fokker Corporation secures the basic scientific and design work for the Russian side. For the scientific research institute, having much experience in developing such systems, the agreement with the ESA is becoming the first step on the path to the world space technologies market. ESA specialists preferred the Russian 35-ton

rescue system, having better operational characteristics and a low cost, over similar systems from the United States and Great Britain.

Telephone number of the Parachute Making Scientific Research Institute: (095) 462-13-19

### Mutual Reliance of Russian, Ukrainian Space Programs Stressed

*937Q0161 Moscow ROSSIYA in Russian No 31, 28 Jul-03 Aug 93 p 4*

[Article by V. Kolinko, from Kiev: "There's Not Enough Strength To Divide Up Space. And It Wouldn't Be Worth It"]

[Text] The National Space Agency of Ukraine (NSAU) was created a year ago. That step legally confirmed Ukraine's right to call itself a space power. But actually, Ukraine has had that status for a long time: over recent decades the scientific and industrial potential of Ukraine was active in virtually all the space programs of the Soviet Union.

After the breakup of the USSR, many specialists involved in space were keenly aware of the situation: the surgical operation to separate the "Siamese space twins"—Russia and Ukraine—didn't hold much promise and was even dangerous to both "halves."

After all, how do you cut apart a living thing?

Take just the NPO Yuzhnyy mashinostroitelnyy zavod [Southern Machine Building Plant] in Dnepropetrovsk. The Zenit and Tsiklon launchers that they produce have to this day been the primary "delivery vehicles" for sending spacecraft into near-Earth orbit. Today, some 840 enterprises of the former USSR—from Russia, Moldova, Armenia, and the Baltic countries—participate in the running of just the Zenit program alone. And if, say, the NPO Energiya were to stop delivery to Dnepropetrovsk of first-stage motors, you would have to put a cross up over Zenit tomorrow. In the meantime, the Russian rocket complex Energiya could suffer the same fate: without the Dnepropetrovsk "peripherals," it would just sit on the launch pad.

And it turns out that Deputy General Designer of NPO Energiya V. Filin was right when he said this during a recent meeting with Ukrainian legislators:

"Without Ukraine, we will perish, just as she will without us."

And the NSAU general director, V. Gorbulin, added this:

"We cannot work without each other, and we simply have to consolidate our efforts in the exploration of space."

Fortunately, the common sense of space researchers has turned out to have the upper hand over the sloganeering of advocates of nationalism and their demands to divide up the spacecraft in near-Earth orbits and especially over the destructive efforts to downsize space research in Ukraine, which, as a result, would have meant the death of its space potential.

And that would be no small thing. Because it wouldn't affect just the Dnepropetrovsk Zenit and Tsiklon rockets, which are regarded by specialists as among the best in the world.

It would also affect the science institutions of Kiev that specialize in space-related instrument-making and space materials-science, the Kharkov scientific-technical complex that produces the control systems for many kinds of spacecraft, and the space sectors of Uzhgorod, Lvov, and Odessa.

Finally, Ukraine has three ground stations and two maritime stations for deep-space communications, one such station, near Yevpatoria, being rather unique. And there's more. Ukraine has a monopoly on the construction of large structures in space, as well as on the repair of such structures. Its achievements in that area are so considerable that it even attracts clients from far-flung countries abroad.

All that would perish if the collaboration with Russia were to cease. By itself, Ukraine couldn't begin to execute any serious space programs before the next century.

After all, even with launch vehicles and its own production of satellites, it doesn't have a launch facility to send them up. The idea of building a joint facility on the Australian continent was brought up, but the matter hasn't gotten any farther than the talks stage. There have been discussions of projects involving the creation of a sea-based launch pad and even a flying platform, which would involve either the not-yet-completed heavy aircraft carrier Varyag at the Nikolayev wharfs or the Mriya and Ruslan heavy aircraft. But doing those things would be so expensive and complicated in technical terms that it's virtually infeasible.

In the meantime, with the proper financing at the state level, Ukraine could solve the problems associated with a launch facility, a flight control center, and centers for processing the telemetry data that would come from satellites. But there's no money for that as yet, and the state of the republic's economy makes it senseless to expect such money in the near future.

"The national space program that has been prepared," says NSAU General Director Gorbulin, "calls for entry into the world space market in the future. But that is, so to speak, the second stage. The first stage is the solid, unconditional integration with the Russian Federation, with the preservation and development of existing ties and joint work on the execution of the interstate program already prepared by the academies of science of both countries. We may have some excellent prospects."

Those prospects may include, for example, the joint re-working of the environmentally clean Zenit (fitting it with an upper stage). The use of the Zenit could enable future launches of spacecraft into high geostationary orbit, as well as deep-space research. In addition, such an inexpensive launch vehicle could compete successfully on the world aerospace market, too.

In a word, everything boils down to the logical conclusion that Kiev and Moscow, and other places apparently, will be in space together.

"And today, Russian is a strong world space power," says the prominent Ukrainian astrophysicist, Academician Yaroslav Yatskiv. "But alone, it would be difficult for her to carry the expensive burden of space research. The answer is to combine our efforts. And we're already seeing that process under way. Ukraine is participating in Mars-94 and Mars-96 programs of the Russian Academy of Science's Space Research Institute. As equals, we are also taking part in the international Mars program whose culmination will be a manned mission to the 'Red Planet.'"

## RSA Director Koptev on Space Sector's Shortage of Funds, Critical Problems

*937Q0182A St. Petersburg NEVSKOYE VREMYA in Russian No 149, 7 Aug 93 p 1*

[Article by Maksim Shabalin (received by telephone from Moscow): "Space Requires Money"]

[Text] Yuriy Koptev, director of the Russian Space Agency, states: "The peak of space activity in Russia and in the former USSR was in 1989 when space expenditures amounted to 6.9 billion rubles at the prices at that time. Then a decline began. Now civilian programs have been reduced by 30% and military programs by 70%. Due to the very severe reductions in military orders a serious problem has arisen: how to preserve that potential which was built up over the decades."

"Today our work is being carried out in the following directions: support for communication and TV broadcasting, support for navigation, organization of rescue of those who have experienced misfortune on the sea and on the land, astrophysical research, remote sensing of the Earth, meteorology and, it goes without saying, a large manned flight program. In the budget for this year we have been allocated 81 billion rubles and as of today we have received 31% of this sum. We have a unique experimental base. The cost of the fixed assets was about 90 billion. But with the curtailment of defense work this experimental base hangs like a dead weight on the enterprises and they are faced with a choice: whether or not to reduce all this to scrap metal, although individual apparatuses have no equal elsewhere in the world."

"Still another problem is that of personnel. The number of people employed in space science is being reduced. During recent years 34% of the 'brains' have been lost. One of the explanations is the extremely low wages. According to data for the second quarter, the average salary for our specialists is 19 000 rubles."

"And this is occurring against the background of a universal rise in prices. During 1992 for the country as a whole the materials of interest to us rose in cost by a factor of 270. But our operations, taking into account the low wages and the freezing of social payments, during this same time rose in cost by a factor of only 41. In their time many have said that space is ruinous. But in the budget we were allocated 0.39%. It seems to me that such a sum in no way can ruin the country."

"In general, I do understand very well how we will wind up this year. The principal engine plants are on the verge of a shutdown. The matter of Baykonur has not yet been finally solved. But under the program we must still carry out 32 launchings. I understand that the country is in a very difficult situation, but if some additional sources are not found Russia after 1.5-2 years may cease to exist as a space power."

"However, at present we have nothing to sell other than oil, timber and space. So let's treat the space complex at least as well as the fuel-energy complex. There is no need to preserve all the 300 space-associated enterprises, but it is necessary to keep a half-hundred and afford them the possibility for survival. Why should we receive 18 000 rubles monthly whereas oil industry workers receive 80 000? Who can explain that to me?"

P.S. See p 4 for information on the conflict arising due to suspension of the Russian-Indian contract for cryogenic engines.

## Russian Space Technology Exhibited at South Korean 'EXPO-93'

*937Q0180A Moscow KRASNAYA ZVEZDA in Russian 13 Aug 93 p 1*

[Article by Valeriy Baberdin, KRASNAYA ZVEZDA correspondent: "EXPO- 93: Today Russians Stroll About the Festival of the Intellect. But Tomorrow?"]

[Text] The attention of thousands and thousands of specialists is riveted today on the South Korean city of Taejon, 160 km from Seoul. Here, as the Koreans themselves say, the "Second Olympiad" is in progress. The EXPO-93 exhibition is a wide array of scientific fantasy, unexpected engineering designs and a parade of supermodern technologies. This is the sort of show where the intellectual capabilities of all mankind are demonstrated.

Three exhibition modules with an area of almost a thousand square meters plus an open area have been allocated here for Russia. Space technology occupies the central place in the Russian exhibit. It is enjoying enormous popularity among the Koreans.

How the exhibit was prepared can be told and retold. The decision that Russia was to participate was already

made last year by the presidents of the two countries. Then refinements and agreements followed...

As a result, only the most limited time remained for the preparatory work itself and nevertheless it all could be managed.

The unanticipated and therefore the heaviest task rested on the shoulders of the engineers and workers of the Machine Building Plant imeni Khrunichev. At the request of EXPO organizers they had to prepare and display a mockup of the Mir space complex in its full size. Everything should be like it is there in orbit: the main unit and the modules: "Kvant-1" astrophysical module, "Kvant-2" resupply module and "Kristall" technological module.

"At the plant the body of the Mir was assembled quite rapidly," says Anatoliy Krylov, deputy of the RSA administration for foreign relations, "outfitting it with operating mockups of on-board systems, instruments and equipment. In addition, technological stands were constructed: a rather solid platform was obtained; after all, the mass of the complex was more than a hundred tons. Its transport to Korea also was a problem."

The fliers of the military air transport service solved this problem. Aboard the Anteya transport aircraft there were four shipboard crew commanders: Valentin Mikhaylovskiy, Igor Zaytsev, Nikolay Kostyashov and Sergey Radcheyev. They delivered the modules to Seoul. Then they were transported to Taejon and there, over the course of 50 days, 20 assemblers from the Khrunichev plant assembled the whole works.

Also flown to Korea was our "Martian Rover," the prototype of that vehicle which will participate in expeditions under the "Mars-94" and "Mars-96" projects. It has passed through all possible tests, including in the American Mojave Desert, has been further upgraded, and now is ready for the launching. In the pavilion where the vehicle is being demonstrated our engineers have constructed an entire "marsodrome." It is a surface quite precisely duplicating the mysterious planet.

The Vostok 6 descent module, in which Valentina Tereshkova flew into space and landed, also is on display in the open area. It must be said that many "things" have been exhibited at Taejon which only yesterday were stamped "Secret." This includes a hypersonic aircraft-rocket from the Bor series, a prototype of the Buran, and the Resurs, Gals and Glonas satellites...

The NPO imeni Lavochkin for the first time put on display the new spacecraft Kulon (a quite heavy vehicle, crammed with instrumentation). It is the principal component of the powerful "Bankir" information- computer system used by the Central Bank of Russia.

But we are not showing off space alone at Taejon. Original scientific developments were brought by the institutes of the Russian Academy of Sciences, samples of production from conversion of military plants are causing enormous interest and interesting technical solutions are being demonstrated by nongovernmental organizations of the type of the newly formed Zemlya i Kosmos [Earth and Space] Association.

Everything is fine. In actuality we look quite good at this world festival of the intellect. We are interesting even for such a public spoiled by exotic technical developments as the Koreans. But this is today. What will it be tomorrow? To tell the truth, the developments which are on display at EXPO-93 are all old baggage representing scientific accomplishments of past years.

Even now we have come to a standstill in scientific research. Our institutes are in a blind alley. Scientific research programs are not being financed, scientists for a long time in essence have not been working; advantageous positions are being sought in the industrial sphere and in private companies and the strongest and youngest are striving to emigrate. All this will tell on us tomorrow. That same space industry on which it was necessary to pin our hopes. Its developments and technologies until now have been at the center of interest of Western companies. But today it is in a state of precardiac arrest.

Here are only some figures. Space industry enterprises have lost 30% of their highly skilled specialists and scientific institutions have lost 34% of their professors and assistant professors. The average salary for persons working in the space field is a little more than 19,000 rubles.

We scarcely could have arrived at the exhibition in Taejon if it were not for interested parties in South Korea. They provided us on a cost- free basis use of the entire exhibition area and paid, in particular, the costs for fabricating, transporting and assembly of the Mir orbital complex and sustenance of the servicing personnel... All this is offensive for a great country.

And suddenly the thought occurred, possibly should we desist from participation in such forums? Especially since in this case there was no commerce involved: all deals were officially forbidden at all EXPO exhibits. Does this mean that we should completely self-isolate ourselves, cease our scientific-technical research and reorient ourselves on foreign companies? But we, however, are going for membership in the world community on an equal-partner basis. We have the image of a creative, inventive country. Is it impossible that we cannot further surprise the world? Not everything has gone down the drain. We can still climb out of the economic hole. That is something which we must believe.

## Former Director of Electromechanics Institute Discusses Early Classified Work, Current Project

*937Q0184 Moscow NEZAVISIMAYA GAZETA in Russian 19 Aug 93 p 6*

[Interview with Nikolay Nikolayevich Sheremetyevskiy, former director of the All-Russian Electromechanics Institute and currently a staff member there, by Sergey Tyunkin, under the rubric "Eyewitness": "'The Secrecy Really Got in Our Way,' Says Academician Nikolay Sheremetyevskiy"; first two paragraphs are source introduction]

[Text] The name of Nikolay Nikolayevich Sheremetyevskiy, like the names of many other "secret" scientists, is not well known to the general public. Right before the war, in 1940, Sheremetyevskiy graduated from the Moscow Power-Engineering Institute. A year before that, while he was preparing to take a degree at the All-Union Electromechanics Institute, he became acquainted with Professor Andronik Iosifyan. When the war broke out, Iosifyan became the chief figure behind the creation of a special electromechanics plant, which was to work for the defense of the country. And that's when Andronik Gevondovich [Iosifyan] remembered the young degree-seeker and invited him to work at the plant. Sheremetyevskiy began working there at that point, and still works there to this day.

Since that time, the fairly small plant has become one of the country's leading institutes, the All-Russian Electromechanics Institute. Sheremetyevskiy was long the head of the institute, until 1991. Now, even though he is 75, he continues to work there.

**Nezavisimaya Gazeta:** In the West, they say that we borrowed many of our advances from them or, to put it simply, that we stole them. In your view, how much of a basis do those assertions have?

**Sheremetyevskiy:** I can't speak for others, I just don't know. But I can talk about our institute. Right after the war, we were invited to participate in the analysis of the captured German equipment, and we were the chief "electricians" for the whole missile thing.

All the electrical equipment that was later mounted on Korolev's rockets we initially took from the Germans and then improved. Now not a single rocket or a single satellite goes aloft without our electromechanics. And in that regard, we went far beyond what the Germans did.

Or here's another example. The first of the American airplanes that crossed into our air space, and that we managed to land, was the B-29. That was in '45 or '46, I don't remember exactly. Stalin, the "father of the people," really liked that B-29. And we copied that airplane inch for inch. With that work, our institute essentially laid the foundation of electrical engineering in the aircraft industry. Could that be called industrial espionage? I don't know. It probably could. But that kind of thing is done all over the world. The Americans, too, are engaged in that very same thing with regard to our equipment, and they copy it just the same way. Something similar occurred in the development of our Zenit rockets. We got a guided missile from the Germans and copied it. Then, of course, the son of Beriya came along, and they took that research area away from us. He himself became the head of the 1323 organization. That organization handled the systems of the Zenit guided missiles, and just one of them terrified everyone. The son of Beriya—what do you expect?!

At any rate, that's how the basis of our electrical engineering science and industry was laid. Then, of course, we followed our own path.

Our electromechanical systems for the attitude control of orbital stations, for example, are original, and there are none like them anywhere else.

**Nezavisimaya Gazeta:** But haven't others tried to "borrow" things from you at times?

**Sheremetyevskiy:** Yes, more than once, then and now. Take, for example, the magnetically suspended sphere—foreigners want very much to know how we did that. Sure, we'll tell them how we did it! (He makes a gesture with three fingers—*S. T.*) If you need the technology, buy it.

**Nezavisimaya Gazeta:** Does that sphere have any practical value, or is it just a pretty toy?

**Sheremetyevskiy:** Of course it has practical value! Turning in any direction, it compensates for the moments of momentum that arise in a satellite and maintains it very precisely in orbit. An attitude-control system based on such a sphere gyroscope enabled the Mir station to discover a supernova by precisely pointing the station at the star.

**Nezavisimaya Gazeta:** If you can, without revealing any state secret, of course, could you tell us about any interesting classified work?

**Sheremetyevskiy:** Well, let's look at what we mean by classified. In the not-too-distant past, many research areas were classified without any good reason for it, and many still are today. For example, work done in meteorology and with orbital stations were "top secret," with absolutely no basis for it. In the very same way, much of the work we did with S. P. Korolev's organization was labelled secret for reasons that were totally incomprehensible to me. In the first place, we were very far behind the Americans there. We weren't on the Moon, hadn't performed such a circus trick like landing people there and then taking them back up off the surface. Those were all control operations that we couldn't even dream of. And for that reason, the "secrecy" we had really got in the way of our integrating into world science and technology. Besides, you have to distinguish commercial secrets from military secrets that affect the defense capability of the country.

But perhaps I'll tell you about one bit of work that used to be very secret. At the very height of the cold war, it became apparent that we were behind in the area of submarines. Our submarines were very noisy and could be easily detected by foreign detection systems. Reducing the noise substantially was one of the tasks assigned by the government to scientists. Another, more interesting problem involved the development of a miniature fighter-submarine. It was to be able to travel underwater at speeds of more than 40 knots an hour and, upon detecting an enemy submarine, would be able to easily catch it and destroy it. Its crew—as I remember, although I may be mistaken—was to be around 17 men, and not the 100 or so of an ordinary submarine.

**Nezavisimaya Gazeta:** Was that submarine to have an atomic power plant?

**Sheremetyevskiy:** Yes, with a nuclear reactor. And at one time, the development of that fighter-submarine among our top priorities. Academician Artsimovich was named director of the project. Our job, as electrical engineers, was to substantially reduce the size, weight, and noise of the microcraft. With an eye to that, we developed a full-scale ground test-stand consisting of all the power-engineering equipment of the submarine, and we worked out the boat's structural configuration on the stand. But the suitability of the entire structure hadn't been studied thoroughly enough in terms of electrical engineering and power engineering. Besides, Artsimovich died. And even though the boat had actually been put together, the project was closed down.

Huge amounts of money that nobody back then was even counting was spent on the project. But then, you can't say that all that money was spent for nothing. The people who took part in the project garnered an immense amount of experience that was useful in the development of larger underwater craft. Although, as I understand, the negative experience of all the organizations that took part in the development of equipment for the submarines has not been studied properly, right now there is no "high road" for the development of a new generation of submarines. In fact, the production of them is being steadily cut back.

**Nezavisimaya Gazeta:** What are you doing right now?

**Sheremetyevskiy:** I am the science director of a completely new and, I would say, unique project. Everything that I have collected over my long life for satellite control systems, I'm trying to bury.

Yes, yes, I am involved right now with the development of an automated system for the directional drilling of oil wells. Why don't we have much oil? Because we're not pumping it all out. And we're not pumping it all out, because oil pools have complex configurations and complex relief. And mainly, we just know how to drill vertically. What a vertical pipe can pull out is very little, and often we need to drill horizontally. So there we need to guide the drill in three dimensions beneath the surface. And we're adapting the sensors that we've put on satellites for the underground orientation of the drill. If geophysical exploration provides us with the proper trajectory, then the electromechanical system for controlling the attitude of the drill can follow that trajectory precisely. And all the oil will be ours.

## NPO Polet To Begin Production of An-74 Airplanes

*937Q0182B Moscow IZVESTIYA in Russian 19 Aug 93 First Edition p 2*

[Article by Sergey Suslikov, IZVESTIYA correspondent, Omsk: "Aircraft Instead of a Rocket"; the first paragraph is an introduction]

[Text] The Polet Aerospace Association, specializing in the production of military rockets, boosters, satellites and the famed Buran, has mastered production of the intermediate-class An-74 civilian transport-passenger aircraft. The production of the aircraft was organized in a record short time. In September plans call for flight tests of the first An-74. Two more planes are on line. The technical design of the An's is many-sided and provides for four variants: arctic for ice reconnaissance, transport, transport-passenger and 70-seat passenger. The aircraft can take off from a drifting floe measuring 900-1200 m, short earthen, gravelly and snow strips. The first plane was constructed in the transport variant. It is stated that the An-74 has good possibilities and there is a demand for it.

## Russian Providers of Satellite Insurance Likely To Increase Rates

*937Q0198A Moscow KOMMERSANT DAILY in Russian 21 Aug 93 p 7*

[Article by Viktoriya Lebedeva: "Insuring of Space Risks Is Becoming More Expensive"; the first paragraph is an introduction]

[Text] Yesterday the Kosmicheskaya svyaz Production Association, specializing in the operation of communication satellites, directed to a number of Moscow insurance companies, including the Rossiya, Podmoskovye and Vesta companies, a claim for compensation for losses under a contract for insuring the Gorizont-39 satellite. In the course of the month the insurers will have to pay out 250 million rubles for the satellite, which was unable to enter the stipulated orbit. The insuring of space risks has become almost traditional for the Russian market. The Kosmicheskaya svyaz [Space Communication] enterprise, which has insured its satellites since last year, constantly works together with a number of commercial insurance companies, in particular, with Rossiya and Vesta. Since the sums of risks under the contracts for insuring satellites are rather great, the insurance companies divide them up and under the conditions of the contract each insurer is directly responsible to the client within the limits of that sum which it had assumed. If the amount of the loss is less than the

insured sum, each insurer pays out compensation proportional to its fraction of participation in the risk. When insuring satellites such a system most likely is not very convenient to the client because sometimes the client must collect compensation from ten insurance companies, which, for the time being, is perhaps the only way possible. It is difficult to employ a reinsurance arrangement because under reinsurance conditions the insurer first of all must itself pay the client, and only then receives compensation from the reinsurer. In the case of insuring high risks problems may jarise here; it is not precluded that at the required moment the insurance company will not have the money. The Gorizont-39, whose launching took place on 27 May at the Baykonur cosmodrome, was ensured for 250 million rubles—a sum below its real cost. In general, underinsurance is a rather common practice by clients in order to reduce premiums. The reason is that according to current legislation the insured parties do not have the right to assign the amount of insurance premiums to costs and have been forced to make payments from their profit. As a result, upon occurrence of an insured case the insured party does not receive full compensation for his losses. The insurers were 11 Moscow insurance companies and Rossiya, Zhiva, Podmoskovye, Rosno and Vesta each assumed 14% of the total risk. The Gorizont-39 did not enter the stipulated orbit. After determining the reasons for the failure (malfunction in operation of the booster engines) the Kosmicheskaya svyaz enterprise put in a claim with the insurance companies for compensation. Despite the fact that not one of the participating insurers had to pay out more than 35 million rubles, the insurers most likely regarded this insurance event to be quite serious. According to Yuriy Kostenko, the director of the section on insurance for aviation and space risks of the Rossiya Insurance Association, up to the present moment the going rate for satellites has been 8% of the insured sum. It is entirely possible that now its cost will increase to 10-12%.

## History of Chelomey Organization's Small Spaceplane Project

*937Q0189A Moscow TRUD in Russian 26 Aug 93 p 6*

[Article by Mikhail Rudenko: "'Star Wars'—History of 'Death' of a Unique Spaceplane"; the first paragraph is an introduction]

[Text] The American Space Shuttles continue to make themselves at home in circumterrestrial space. The single flight of our Buran multiply reusable orbital ship long ago has faded against this background. This gives such an impression that an attempt can be made to show that we through our own negligence for a long time have undermined the strength of the Soviet (and now Russian) space industry. However, everything probably could have turned out otherwise. The fact is that long before the Buran flight a "spaceplane" was developed in our country which had unique capabilities. But the enterprise where this project was carried out had fallen into disfavor. In addition, the scientists had made this vehicle "on the sly," without instructions of the Party and government authorizing this. And therefore the unsanctioned rocket plane never saw the stars...

The idea of creating a multiply reusable space vehicle which could take off like a rocket and land like an aircraft was born long before the flights of the first cosmonauts. Actual work on rocket planes at the enterprise headed by Academician Chelomey (OKB-52) began in 1960. The scientist had to solve more than a few problems: carry out very complex gas dynamical computations, make up a mockup of the systems, test it in a wind tunnel, develop spacesuits for cosmonauts, catapulting seats and a system for rescuing the crew and the ship as a whole... An avalanche of problems, one more complex than the other, tumbling down on the designers. But everything turned out well...

"After only a year the project had reached the point of experimental launchings of full-size models," relates A. Petrov, the chief designer. "The most amazing thing was how we tore ahead, skipping even the initial drafts, immediately going on to the working plans stage, and even with such a speed how we nevertheless created heat shielding for the vehicle which even today has no analogues in the world with respect to reliability and practical feasibility."

**Engineer-Colonel Aleksandr Vasilyev recalls:**

"The snowy morning of 27 December 1961. Launch pad No 1 at the Air Force test site. My detachment of inspectors and I were delivered there by helicopter. At the launch pad was an R-12 beauty, covered with hoarfrost, to whose second stage was attached a model of a rocket plane instead of a warhead. At a distance of 800 m I observed the launching of the booster... Everything went off successfully. And forty minutes after the launching we received a joyful radio communication: the vehicle had passed through the atmosphere and had successfully landed by parachute. A day later with the fellows from the State Commission we examined the object and were surprised: almost all the heat shielding was intact; moreover even the on-board instrumentation remained completely operable... How's that for development work!"

The rates of work on the rocket plane were surprising. However, judge for yourselves.

Tests of the second full-size model of the rocket plane, designated in the accompanying documentation as "object 0201," were carried out in March 1963. The launching took place from the same pad as the preceding time. And again everything went off so smoothly, without a hitch, that the chairman of the State Commission, Major General A. Zakhorov, on the morning of the next day had already reported to the headquarters command: "...A new technical problem for creating a controllable space vehicle was worked through in a short time."

In November 1963 the Chelomey group had already launched a full-size object which entered into the history of cosmonautics as the Polet-1 satellite, maneuvering in orbit.

Already after 1 ½ months the Polet-2 repeated the triumph. It is true that with this the successes ceased. But not due to the developers. The fact is that the General Designer at the OKB-52, Vladimir Nikolayevich Chelomey, was among the favorites of Khrushchev. And then came a change in authority...

"The overthrow of Khrushchev almost cut all our efforts off at the roots," said brigade chief B. Nikolayev. "The comrades in the ministry literally instantaneously shifted gears from 'universal approval' of our projects to total suppression of any initiative of ours. A menacing commission arrived at the enterprise for 'looking into' the activity of the OKB, which with enthusiasm began to undermine the General Designer..."

**Engineer-Colonel Aleksandr Vasilyev states:**

"Remember the 1970's? The 'Cold War' at its height. The Americans launch their Shuttle—a multiply reusable space-based transport system. In 1974 the enterprise at Podlipky was headed by V. P. Glushko and the lads from there began to hint in the lobbies that their new chief also intended to participate in the race. Chelomey began to feel uneasy..."

"Once, arriving at work sooner than usual," recalls Boris Nikolayev, "I was terribly surprised on discovering Chelomey at my drafting table. What was up?! In silence he drew two photographs from his inner coat pocket. They showed virtually precise copies of the Space Shuttle. Vladimir Nikolayevich pointed to one of the photographs: 'Here is what Valentin Petrovich Glushko has cooked up. The size difference from the American ship is plus or minus a half-meter...'"

**The Chief Designer Anatoliy Petrov tells:**

"Vladimir Nikolayevich entered room No 6, gathered together 10-12 persons and began a harsh critique of both Shuttles—the American and the Soviet, the product of the Energiya NPO: unwieldy, expensive, and most importantly, both in need of new powerful boosters. And he right on the spot gave the assignment: develop a light spaceplane (LSP) as an economical alternative to the 'official' project, named, in his words, the Buran. And we sat down to sketch the variants..."

Chelomey's principal trump card was the availability of the Proton, a powerful new booster, by that time already beautifully recommending itself.

"If a 20-ton rocket plane is made, it will without difficulty put a 4-5- ton payload into orbit," reasoned the academician. "Launchings with the Proton also were ready long ago, with two positions for each. The finalized design and technological accomplishments were mass, engines, control system components, crew life support system, heat regulation system...; only heat shielding was lacking! And all of this had been repeatedly tested and checked in space!.."

**Mark Bendetov, the chief designer, recalls:**

"As soon as we began to speak out aloud about our undertaking—I refer to a small multipurpose multiply reusable spaceplane, a storm arose in our rocket-building 'capital':

'Where did Chelomey get the idea that such a light vehicle will fly? After all, there has never been anything like this! This contradicts all the laws of physics, mechanics and aerodynamics! We have seen such geniuses!'

But at our enterprise, meanwhile, the outlines of the first 'tailless' aircraft design with a low-positioned double sweptback wing had already appeared on Whatman paper. The key component of the vehicle was its engines, ensuring not only the orbital maneuvering of the vehicle and the correction of its flight trajectory, but also braking during descent from orbit. And the engines had already passed through a major program of stand and flight tests!"

"Being a man of action," tells V. Nesterov, a section head, "not liking to play patience with the apparat, Chelomey soon addressed the General Secretary Leonid Brezhnev himself with an engineering note in which he asked him, without mincing words, to make a decision about the LSP. The bureaucratic machine for months turned this proposal in its millstones. And as a result a large commission headed by Army General V. M. Shabanov arrived at our enterprise 'for examining the problem.'"

V. N. Chelomey was strained to the limit: after all, a commission of such a level virtually always was concerned with pure policy, no way with technology. And so it turned out. After ten days a "decision" arrived: Chelomey's proposal was rejected.

"We middle-level directors could only speculate about the 'struggle of the giants' at the very 'top,'" says the leading designer A. Petrov. "But the moment came when Vladimir Nikolayevich dealt with us openly. His secretary gathered us together in his office using a special list drawn up by himself and the academician delivered a speech dramatic in its unprecedented candor and sincerity. His watchword can be expressed in a single sentence: if the leaders do not grant us permission to make the light spaceplane legally, in the open, we will do it undercover!"

We understood that Chelomey had been driven to the wall, arousing the animal instinct in him...

**Boris Nikolayev:**

"Beginning the next morning our 'personal life' ended: we spent day and night at the enterprise and forgot days off. On rare occasions we slipped home to take a shower and see a little of our young offspring. The builders

pressed hard for the design documentation, which immediately was torn from the drafting tables, from the hands of the draftsmen, and they ran to the workshops to embody the sketches in metal."

And a miracle happened: only a month after issuance of the order of the General Designer on "conducting a research experiment for checking a promising technical solution," a rocket plane of a bright green color, with red stars on the wings and the inscription "USSR" on the fuselage, stood in the hangar ready for flight. The seats for the pilots sparkled with nickel in the vehicle cabin; these were later transferred to the Buran at the Energiya NPO.

The next day, at 11 o'clock, a shiny limousine with Dmitriy Fedorovich Ustinov slipped through the entrance gates. He and Chelomey entered the hangar, the secretary of the Central Committee swiftly climbed up the steps into the aircraft cabin, followed by the General Designer. For twenty minutes they quietly conversed with one another, emphasizing their words with eloquent gestures. After Ustinov's departure the design bureau workers asked Vladimir Nikolayev: what are the chances of survival for our innovation?

The answer was: "We should have no delusions. Things have gone too far with the Buran, too much has already been spent on it and scarcely anyone wants to turn the situation around..."

**Boris Nikolayev:**

"As things proceeded the merits of our LSP were manifested increasingly more clearly: in particular, its aerodynamic quality was substantially greater than this highly important index for the Shuttle and the Buran. In contrast to these 'competitors,' our vehicle could make a landing, without exaggeration, at any point on the globe, and its landing speed did not differ from the speed of any modern passenger liner. It also was more economical than the other two..."

Meanwhile the ministerial informers were not asleep. They sniffed out what was going on and in the best traditions of the stagnant times "passed the word" to the leaders and Chelomey was called on the carpet, summoned to the office of the minister, S. Afanasyev. No one knows to this day what the conversation was like. However, veterans of the Ministry of General Machine Building assert that at the time when the academician was in the minister's office the entry door of fumed oak for some reason or another cracked...

Chelomey returned with a reprimand along the Party line "for irresponsible" overexpenditure of state money in the amount of 140 000 rubles. He gathered together his fellow workers, was silent for a minute and quietly stated:

"I have just returned from the funeral of the LSP. The grave diggers of progress did their dirty deed..."

The Chelomey spaceplane thus did not see the stars, ruined by the "games of the apparat." And now it only remains to deplore this. But did we draw any conclusion from this history? Indeed, even today, when cosmonautics is experiencing particularly difficult times, the design bureaus are continuing to give birth to bold projects which are ahead of their time. We should not overlook them, should not ruin them, citing economic difficulties. Indeed, the future of star ships even now is being born. And it will be sorrowful if our descendants call these years the "times of missed opportunities"...

## Russian Space Program Said To Be Subordinated to U.S. Interests

*937Q0199 Moscow PRAVDA in Russian 4 Sep 93 p 2*

[Article by Anatoliy Pokrovskiy: "Reward for Obedience: They Called Out in Washington, and Baykonur Echoed a Response"]

[Text] On the very eve of Chernomyrdin's visit to the United States, I remembered an old story, from 1975. Back then, on the threshold of the flight of Soyuz and Apollo, our country had its first public conversation about the cost of space trips. The Americans said outright that the launch of the Apollo would cost them $25 million. And then they asked what the Soyuz flight would cost.

The then-chairman of Interkosmos, now-deceased Boris Nikolayevich Petrov, spent about 25 minutes answering the question, but didn't name a figure. You could understand where the academician was coming from: he wasn't trying to deceive anybody—he just didn't know what it would cost. What's the use—"I'm rich, I don't count the money, and there's still plenty of everything we need."

But now the things we need have, in fact, gotten scarce, and the market times are here. And it's no longer an ordinary academician who can do a good job of counting the money in someone else's pocket, but a prime minister, and he's jingling the change in his own pocket. "I don't intend to ask for anything in America," he says in a pre-visit interview. And he explains that with an example from space like this: "We're going to help them (the Americans—A. P.) develop an orbital station; they'll earn more than $2 billion on that."

Good for the Americans. But what will we get out of it? "Whatever we earn," he follows with an answer, "it'll all be ours. We're not going to be specific about it."

It's some sort of strange, one-sided commercial secret. But is it really a secret? It's no secret that they're allowing us into the high-tech space market none too willingly. And if they take us, they'll take only what they can't do without. For example, our experience in the development and long-term operation of orbital stations. And they'll make a little more than $2 billion because they stipulated that among the conditions.

Recall that Viktor Chernomyrdin, right before his visit, announced firmly that Russia had delivered rocket motors to India and would continue to deliver them. And then

here's what our correspondent in Washington, Vladislav Drobkov, reported after the visit: "It was not without pleasure that the press here pointed out that Moscow, despite the widely disseminated announcements of President Boris Yeltsin himself, was forced to retreat and substantially revise its deal with New Delhi under pressure from Washington. In that context, the current agreements on the use of Russian equipment and technology for the American space programs have been interpreted more often than not as a 'reward for obedience.'"

That's how they taking us down from lofty orbits to the lowly earth. And things aren't going any better on the ground, either. For it is on the ground that innovations come about that could be used in the future to conquer the world space market. And such innovations exist. But because of the "obedience," they won't get a chance. A letter from Baykonur reminds us of one such unused innovation.

But first, a little more background. The development of the Energiya launch vehicle, the most powerful in the world, was announced just before the opening of the International Space Congress in Brighton. Oleg Nikolayevich Shishkin, who reported on the Energiya there at Brighton, was smothered with questions that were meticulous and somewhat envious.

Later, I had occasion to visit the Progress plant in Samara, where the Energiya was being developed. To this day, I remember the stories of the plant workers about how they had had to, all of a sudden, give up old orders from other enterprises without having the manpower or the money to realize new ones, so that Energiya could be gotten off the drawing board more quickly.

So here's the letter—rather, it's a copy of an appeal to the heads of government of Russia and Kazakhstan, sent in desperation to PRAVDA, for the addressees are kept under wraps. "The launch pads built for Energiya are falling apart," writes a group that is from the assembly-and-testing complex of the Progress plant, but is located at the launch facility and is involved in the assembly of the Energiya rocket. "The airport at which Buran landed is overgrown with weeds, and we, the workers of a space sector that we were so proud of not so long ago, are put in a weird position.... And even with all that, several assembled rockets and other unique pieces of equipment are in storage in the building, and visiting foreign delegations continue to marvel and admire the complex...."

"Just what has forced us to turn to you?" [they continue]. "We're not miners. A strike? We're not trying to scare anybody—that's not in our tradition. We just want one thing: we want Kazakhstan, on whose territory the dying complexes are located, or Russia, whose people are trying to save those complexes, to say whether all this is needed. Yes or no? We're sick and tired of hearing that the complex will get funding, the way it did before, and then not getting any wages for months at a time. You can't do it yourselves, so send the word out to the rest of the world: maybe there's someone out there who needs these immense production facilities with airports and railways."

How we offer our space-related advances to the world became apparent after the agreement between Russia and the United States. And the actual price of that wealth became apparent, too. Can it really be true that with our space wealth, Russia has been relegated to the role of space beggar?

## Baykonur Chief Says Russian Troops Needed

*937Q0196A Moscow PRAVDA in Russian*
*7 Sep 93 pp 1, 2*

[Article by Lieutenant General Aleksey Shumilin, chief of the Baykonur Space Launch Complex, Hero of Socialist Labor, State Prize winner: "A Cloud Over the Space Launch Complex"]

[Text] *Before deciding Baykonur's fate, it is necessary to ask those who work here.*

**The start of the Russian-French crew was marked by another surprise for the world community—"What?... Are they still able to operate?"—and by the unusually prolonged attack by the media on the sore spots of the Baykonur space launch complex. The meeting held on that same day in Leninsk between representative delegations of the Republic of Kazakhstan and the Russian Federation on the fate of the space launch complex, as it turned out, was not adequately prepared for, and it contributed to further confrontation between civilian and military structures rather than to stabilization of the situation at the space launch complex. The subsequent conversation between the Russian and Kazakh presidents did not decide Baykonur's fate either. As a result the fulfillment of the space programs carried out from Kazakh territory was threatened.**

Baykonur is a special mechanism. Created with the labor of the peoples of the USSR, it has outlived its creators and continues, albeit with difficulty, to function as the last structure of the former Union. More and more frequently today one hears opinions about its collapse, and there are attempts to incline the public toward the idea of reorganizing it immediately, without scientific substantiation.

Understanding the complexity of the situation, on 30 July we sent a letter to President of the Republic of Kazakhstan N. Nazarbayev in which we expressed what we considered to be our own constructive position regarding the transformation of the space launch complex. Unfortunately, as subsequent events showed, our information was not accepted by the staff of the president of the Republic of Kazakhstan.

On 7 August 1993 N. Nazarbayev sent B. Yeltsin a personal note which confirmed the seriousness of the president's intention to reorganize the space launch complex into the International Space Company (MKK)

and forced us to think seriously once again about the question of social protection of the military servicemen at the space launch complex under these conditions. It is known that all the facilities here are operated by Russia's military formations. What can the Republic of Kazakhstan and the Russian Space Agency (the initiators of the perestroyka ideas regarding the space launch complex) suggest instead?

Labor collectives formed from civilian personnel and trained? But there are clearly not enough local labor resources of the quantity and quality required for the space launch complex in our region. And how much time will it take to train them in the specialties required for the space launch complex alone (specialists in fueling-neutralization stations, startup complexes, etc.)? Will they be able to work 24 hours a day for the same wages as military servicemen do?

Many are selfishly "concerned" about the Baykonur space launch complex. They include gentlemen from America who "allowed" us to make no more than eight launches of commercial equipment with the Proton rocket carrier before the year 2000; they also include certain correspondents of the CIS who are disturbed by the fact that we are launching more satellites than the United States, and also the Russian Space Agency and the National Aerospace Agency of the Republic of Kazakhstan, which decided to help the space launch complex take a "leap into the future" with international and joint-stock companies without preliminary marketing research, and many others.

Each of these "concerns" pains the hearts of workers of the space launch complex. Does the Homeland really not need the work to which they have devoted a large part of their lives? Will they really share the lot of those forced to resettle without apartments, as happened with hundreds of thousands of military servicemen of the former USSR who were stationed on the territories of the present sovereign states?

Military servicemen of the space launch complex and members of their families cannot find positive answers to these questions either in the speeches of state leaders or in the thoughts of leaders of firms of the space branch, or in the actions of the people's elect.

The main reason for this is the collapse of the economy and the aspiration of each enterprise to survive alone. There has been a disintegration of all sources that previously fed the space launch complex.

The question arises: Is it only Russia and Kazakhstan that need the space launch complex? Let us just recall that with the termination of the launches of space equipment from Baykonur we will not be able to provide the optimal level of security of the borders of the sovereign CIS states either.

But the life of the space launch complex depends solely on Russia's position. Are there investors who wish to form and guarantee financing of commercial structures that will replace parts of the Ministry of Defense of the Russian Federation? They are not to be found in reality. Moreover there is an increasing shortage of officer personnel. The incorrect personnel policy of the past (when it was thought that it was easier to keep an experienced officer at the space launch complex for 20 years than to train young replacements for him) is taking its revenge today. Russian chaps do not want to serve in the troops of the space launch complex since here they have no guarantees of social protection under the present conditions.

The system for carrying out and monitoring test operations which has been arranged over the decades is being violated today. Now it is necessary to form integrated combat teams with one space apparatus, one rocket carrier, one launcher, and one launch complex served by personnel gathered from two or three units stationed dozens of kilometers away from one another. So far this is still possible. In December 1993 a real situation will arise in which we will be forced to stop tests since to conduct them without the required team and without proper monitoring of technological operations will not be safe. Even before the end of the year the legal mechanism for the space launch complex will cease to function; many officers simply will not sign contracts to continue their service and will be discharged in keeping with legislation of Russia. It will not be possible to make up for these losses. Thus the space launch complex will die out naturally.

There is only one way out of this situation—to develop legislative acts and agreements making it possible to determine the future of the space launch complex and its workers at the intergovernmental level and make them work.

In our view, they should include: a memorandum from the presidents of Russia and Kazakhstan (and possibly Ukraine as well) determining the future direction of the policy regarding the space launch complex; an interstate scientific and technical program for reorganization of the space launch complex; an interstate agreement on the legal status of the contingent of units and subdivisions of the Ministry of Defense of the Russian Federation temporarily stationed on the territory of the Republic of Kazakhstan; decrees from the Council of Ministers of the Russian Federation on measures for providing social protection for military servicemen of the Ministry of Defense of the Russian Federation serving at the Baykonur space launch complex and their families.

Drafts of the aforementioned documents have been developed and submitted for consideration in keeping with the established procedure. In our opinion, this only the first step in the attempt to solve the problems of the space launch complex.

It is not very difficult to nationalize all movable and immovable property created by the gigantic state over the decades located on the territory of a sovereign state. What is difficult is to preserve it and enlarge it.

In reality today only Russia is capable of taking on the burden of maintaining and developing the space launch complex. Therefore it would be expedient to prepare and conclude an interstate agreement between the Russian Federation and Kazakhstan for transfer of the space launch complex to Russia free of charge for 30-50 years. Only under these conditions is it possible to make investments in the maintenance and development of the infrastructure of the space launch complex.

If Russia and Kazakhstan are unable to reach such an agreement, the government of Russia must during 1993-1994 solve the problem of stage-by-stage withdrawal of Russian troops from the space launch complex and its transfer into the hands of the incipient joint stock-commercial structures with the main role played by the Republic of Kazakhstan which are capable of carrying out individual target programs for a certain amount of time.

Will Russia be able to retain the space launch complex in today's political situation? Will the members of parliament hear our voice? There is little hope.

In the joint-stock companies, which the Kazakh side and the Russian Space Agency are inclined to create at the space launch complex, there is no real place for military servicemen. According to our estimates, the cofounders of the planned joint-stock companies envision no real financial investments in modernization and reconstruction of the infrastructure of the space launch complex. One can assume that before the year 2000 civilian commercial structures will try to carry out certain space projects, receive their dividends, and then abandon the space launch complex.

One is struck by the haste with which they are trying to radically reconstruct the space launch complex. But where is the scientific approach? Where is the market research? There is none.

The hope that the armed forces of Russia will abandon the space launch complex and that its infrastructure will continue to function after that is essentially misguided.

Today the space launch complex is managed by nontraditional methods and it has specific ties and contacts with outside organizations. It would take others years to learn this. If we eliminate any link in the chain of administration in today's situation, the entire system will become inoperable.

It is possible to mothball Russia's space program, abandon Baykonur, and make launches from the Plesetsk space launch complex. It is possible to wait until the leaders understand how important space is. But the moment will have passed. We will fall behind the West for good. The last area in which Russia could still feel its independence will disappear.

We might create the impression that we military servicemen of the space launch complex do not want to turn it over to civilians.

By no means. If you can, go ahead and take it. But the military servicemen must leave the space launch complex in a civilized way, with well-founded hope in their future.

Esteemed outside rebuilders of Baykonur! We military servicemen will not hold on to the space launch complex or "monopolize" it. We hold Russia's space program in our outstretched hands. Unfortunately, our arms are rapidly growing weak.

## Prospects for Space Cooperation With U.S. Viewed

*934F1170A Moscow SEGODNYA in Russian*
*No 53, 16 Sep 93 p 7*

[Article by Mikhail Chernyshov: "The Prime Minister's 'Space' Portfolio; An Orbital Crane Instead of a Cryogenic Titmouse"]

[Text] According to the press, the visit by the head of the Russian government, Viktor Chernomyrdin, to the USA was not considered noteworthy. Specifically, the space-related results of the trip were not widely publicized. Nevertheless, the secret which the Russian Space Agency, for example, is so carefully keeping, is not a secret at all. The U.S. Congress has already begun debates on the documents submitted to it.

Will we build an orbital station together with the Americans? We will. The representatives of the administration of Russia and the USA believe this.

The construction of the orbital laboratory will evidently extend beyond the boundaries of the current century. If everything goes as planned, Russia can earn up to $1.5 billion from this. The USA will also save a large sum, since its own "Freedom" station would cost much more. The new program, as far as we know, has also been coordinated with other project participants: Japan, Canada, and Western Europe. The Russian "Proton" and "Soyuz" rockets, the West European "Aryan" and the American "Shuttles" are to be used in the construction of the station and its operation.

Before large-scale orbital construction begins, there will be a series of preliminary operations. Part of them is beginning already now. They are being conducted on a commercial basis and will be paid for by the Americans to the Russian side in the amount of $100 million. The second stage of the preparations, from 1994 through 1997, will give another $300 million. What is included in this work? This will be primarily flights by American astronauts on board the currently operating "Mir." There will be several long expeditions, and altogether the "flight time" of the Americans should comprise two years. Aside from this, there are plans to install American apparatus on the "Spektr" and "Priroda" modules, which are part of the "Mir" make-up.

In the course of the negotiations, it was possible to regulate the problems of commercial satellite launches.

The questions of delineating the market are especially sensitive here. An agreement has been reached on setting launch quotas. Russia will be allocated a standard of 12 commercial launches, which may be realized up until the year 2000. It extends only to crafts which have American components. In order to obtain the right to launch, it is necessary to win the tender without resorting to dumping. If Russia is able to meet these conditions, including the regimen of non-proliferation of missile technologies (RKRT [not further expanded]), then for each launch—and this will primarily be "Protons"—the Russian side will get approximately $60 million.

There are plans for cooperation within the sphere of creating a global system of ecological monitoring, as well as fundamental research. There are plans, specifically, for conducting joint work on studying the planets and on astrophysics. Recently, misfortune befell the American research craft, "Observer." NASA has a duplicate of this craft. In principle, it is possible to complete the outfitting with research apparatus within a year and to repeat the launch. A variant of using the Russian "Proton" or "Molniye" rockets for this purpose is being developed. The participants in the talks did not hide the fact that heated battles lie ahead in the U.S. Congress on each of the signed agreements. Many major American corporations see these agreements as an infringement upon their interests. Of course, they will oppose the granting of space contracts to Russia. In search of a compromise, it has been decided to involve practically all the interested parties in the joint work, including such "giants" as "Boing," "McDonnell-Douglas" and others.

Russia has its own problems. We must convince the RF [Russian Federation] parliament that the discussion of the plans for joint work does not constitute a "sellout of the interests of the homeland." For serious work, including international projects, notes the RF government expert Vladimir Pivnyuk, today it is necessary to at least repair the Proton launch complexes and to restore cooperative ties for work on the base unit. Without this, all plans and agreements will merely remain on paper.

BULK RATE
U.S. POSTAGE
PAID
PERMIT NO. 352
MERRIFIELD, VA.

This is a U.S. Government publication. Its contents in no way represent the policies, views, or attitudes of the U.S. Government. Users of this publication may cite FBIS or JPRS provided they do so in a manner clearly identifying them as the secondary source.

Foreign Broadcast Information Service (FBIS) and Joint Publications Research Service (JPRS) publications contain political, military, economic, environmental, and sociological news, commentary, and other information, as well as scientific and technical data and reports. All information has been obtained from foreign radio and television broadcasts, news agency transmissions, newspapers, books, and periodicals. Items generally are processed from the first or best available sources. It should not be inferred that they have been disseminated only in the medium, in the language, or to the area indicated. Items from foreign language sources are translated; those from English-language sources are transcribed. Except for excluding certain diacritics, FBIS renders personal names and place-names in accordance with the romanization systems approved for U.S. Government publications by the U.S. Board of Geographic Names.

Headlines, editorial reports, and material enclosed in brackets [ ] are supplied by FBIS/JPRS. Processing indicators such as [Text] or [Excerpts] in the first line of each item indicate how the information was processed from the original. Unfamiliar names rendered phonetically are enclosed in parentheses. Words or names preceded by a question mark and enclosed in parentheses were not clear from the original source but have been supplied as appropriate to the context. Other unattributed parenthetical notes within the body of an item originate with the source. Times within items are as given by the source. Passages in boldface or italics are as published.

## SUBSCRIPTION/PROCUREMENT INFORMATION

The FBIS DAILY REPORT contains current news and information and is published Monday through Friday in eight volumes: China, East Europe, Central Eurasia, East Asia, Near East & South Asia, Sub-Saharan Africa, Latin America, and West Europe. Supplements to the DAILY REPORTs may also be available periodically and will be distributed to regular DAILY REPORT subscribers. JPRS publications, which include approximately 50 regional, worldwide, and topical reports, generally contain less time-sensitive information and are published periodically.

Current DAILY REPORTs and JPRS publications are listed in *Government Reports Announcements* issued semimonthly by the National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, Virginia 22161 and the *Monthly Catalog of U.S. Government Publications* issued by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

The public may subscribe to either hardcover or microfiche versions of the DAILY REPORTs and JPRS publications through NTIS at the above address or by calling (703) 487-4630. Subscription rates will be provided by NTIS upon request. Subscriptions are available outside the United States from NTIS or appointed foreign dealers. New subscribers should expect a 30-day delay in receipt of the first issue.

U.S. Government offices may obtain subscriptions to the DAILY REPORTs or JPRS publications (hardcover or microfiche) at no charge through their sponsoring organizations. For additional information or assistance, call FBIS, (202) 338-6735,or write to P.O. Box 2604, Washington, D.C. 20013. Department of Defense consumers are required to submit requests through appropriate command validation channels to DIA, RTS-2C, Washington, D.C. 20301. (Telephone: (202) 373-3771, Autovon: 243-3771.)

Back issues or single copies of the DAILY REPORTs and JPRS publications are not available. Both the DAILY REPORTs and the JPRS publications are on file for public reference at the Library of Congress and at many Federal Depository Libraries. Reference copies may also be seen at many public and university libraries throughout the United States.

END OF

FICHE

DATE FILMED

9 DEC 93